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"Promotion of Knowledge of Materials of Engineering and Standardization of Specifications and Methods of Testing"

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R. J. Painter, Associate Editor

Number 127 March 1943

Forty-seventh Annual Meeting in New York City, June 26-30, 1944

Special Sessions; Numerous Paper and Reports

BASED ON STUDIES of the offers of technical papers and on contacts with a large number of technical committees which will have reports for presentation, Committee E-6 on Papers and Publications is developing an interesting technical program for the Society's 1944 (Forty-seventh) Annual Meeting to be held at The Waldorf-Astoria, New York City, during the week beginning June 26. Previous meetings of the Society were held here in 1937, the largest meeting yet held, and in 1912, when A.S.T.M. entertained the International Association. There have been a number of local and district meetings in New York. All technical sessons will be at The Waldorf-Astoria.

It is planned to mail to the members and committee members, probably late in April, an outline of the program indicating major sessions and a list of committees which will present reports at the respective sessions. On the assumption that committee meetings would be held over a day or two-day period prior to the specific session, members will be enabled to estimate the amount of time they will wish to spend at the meeting. This procedure, being used for the first time this year, will enable hotel reservations to be made much earlier than would normally be the case if the communications were not sent until publication of the May BULLETIN. The hotel reservation form will list rates at the Waldorf and several nearby hotels, with a choice of accommodations. The New York Convention and Visitors Bureau is cooperating.

The Provisional Program for the meeting, carrying synopses of the technical papers and reports, will, it is anticipated, be included in the May BULLETIN. The Preprint Request Blank and certain other material will not be sent to members until May 15.

TECHNICAL SESSIONS

Although reasonably final details of the program cannot be announced until publication of the Provisional Program, there are certain features in the offing including what appears to be a most interesting round-table discussion on Centrifugal Castings, in particular, methods of evaluating their properties, selection of test specimens, and such problems.

Members planning to attend the Annual Meeting are urged to read this article. It attempts to answer questions in connection with hotel accommodations, etc.

Definitely scheduled is another round table on Classification of Industrial Waters, to feature five or six formally prepared discussions. Included will be evaluations on treatment of boiler feedwaters used at pressures between 100 and 400 psi., above 400 psi., the use of selected waters in pulp and paper manufacture, etc.

Metals:

In the metals field there will be separate technical papers on a wide variety of subjects including the following: Steels and precipitation-hardened alloys at low temperatures; yielding phenomenon of metals (influence of speed and loading conditions); short-time tests of soldered joints; characteristics of the Tuckerman strain gage; methods for determining hardness conversions for materials softer than 240 Brinell; an alternate immersion test for some aluminum-copper alloys; routine metallographic examination of the commercial magnesium alloys.

Cement and Concrete:

Quite a number of papers in preparation are of distinct interest to those concerned with cement and concrete to provide pertinent information and data on the following topics: Concrete "cylinders" from molds having a slight draft; measurement of concrete strength by embedded pull-out bars; long-time concrete tests comparing dynamic (sonic) and compressive modulus of elasticity, modulus of rupture and compressive strength on a California concrete paving project; properties of concrete under sustained combined stresses; comparison of results of sieving procedures in soundness tests on Maine sands; and entrained air—its effect on the constituents of portland cement concretes; application of fly ash for lean concrete mixes; compressive strengths of cement-lime mortars and effects of consistency and curing conditions; and comparative tests of various brands of cement.

Miscellaneous:

Other papers are in prospect on the following subjects: evaluation of rosins in detergents; test of bituminous materials; chemical changes accompanying sludge formation in mineral transformer oil and selection of absorption of activated carbon. There will be many others.

Cincinnati Spring Meeting Features Outstanding Symposium on Applications of Synthetic Rubbers

More Than 600 Hear 13 Timely Technical Papers

An audience of more than 600 greeted the authors of the 13 technical papers comprising the Symposium on Applications of Synthetic Rubbers held as the feature of the Society's 1944 Spring Meeting at the Netherland Plaza in Cincinnati, Ohio, on Thursday, March 2. Five of the papers were presented in the morning session, covering general industry-wide problems. The remaining eight, at the afternoon meeting, gave latest information on the uses in specific fields of synthetic rubbers. Prior to the meeting, the papers had been carefully reviewed by the Symposium Committee, headed by Arthur W. Carpenter, and all had been released by the appropriate Government authorities, including the Officer of the Rubber Director. Publication of the Symposium is now under way.

Many Consumers and Users at the Meeting:

It is always difficult to decide just what are the more significant features of a technical meeting, but certainly one of the interesting aspects of this meeting was the presence in large numbers of consumers and users of rubber products. Those concerned with the production of rubber and synthetic rubber products were also out in large numbers for the day. The aim of the committee had been to make available latest information on properties and applications of the various synthetic rubbers as applied to fields where rubber products are widely used. Although the last word will still remain to be said many months or years hence, and although in a few instances authors may have been a bit hampered by exigencies of the war situation there was no question of the great intrinsic value of each paper.

The symposium program was as follows:

SYMPOSIUM ON THE APPLICATIONS OF SYNTHETIC RUBBERS

MORNING

The Origin and Development of Synthetic Rubbers—HARRY L. FISHER, U. S. Industrial Chemicals, Inc.

Physical Tests of Synthetic Rubber Products—LESLIE V. COOPER, The Firestone Tire and Rubber Co.

The Physical Properties of the Synthetic Rubbers—JOHN M. BALL and G. C. MAASSEN, R. T. Vanderbilt Co.

Specifications for Synthetic Rubber Compounds—M. J. DEFRANCE, The Goodyear Tire and Rubber Co.

The Processing Characteristics of the Synthetic Rubbers and Their Use in the Manufacture of Extruded Products—A. E. JUVE, The B. F. Goodrich Co.

AFTERNOON

Synthetic Rubber Tires and Inner Tubes—P. M. TORRANCE, The Firestone Tire and Rubber Co.

Hose and Belting Made from Synthetic Rubber—W. L. WHITE, Manhattan Rubber Mfg. Div., of Raybestos-Manhattan, Inc.

The Use of Synthetic Rubbers in Molded Products—MERLE SANGER, The General Tire and Rubber Co.

Cellular Rubbers—LOUIS P. GOULD, Inland Mfg. Div., General Motors Corp.

Hard Rubber Products from Synthetics—WALTER H. JUVE, Consulting Rubber Technologist

Use of Synthetic Rubbers for Insulated Wire and Cable—R. A. SCHATZEL, General Cable Corp.

Use of Synthetic Rubber in Footwear—STANTON GLOVER, United States Rubber Co.

Synthetic Rubber Adhesives—FRED J. WEHMER, Minnesota Mining and Mfg. Co.

Local Activities:

This is the first Spring Meeting of the Society that has been held without the organization of a formal local committee on arrangements or a district committee, to handle local matters. The fact that the activities went off in such excellent shape, and that not only the Spring Meeting itself but Committee Week generally, the evening session with the Cincinnati Technical and Scientific Societies Council—all coordinated perfectly, means that considerable credit must be given to three of the local men who attended to details as somewhat of a team, rather than as an organized committee. John C. Pitzer, Formica Insulation Co., J. W. Bolton, The Lunkenheimer Co., and Frank Sanford, president of the Cincinnati Technical and Scientific Societies Council, had local matters well under control. This involved extending invitations to the some 2800 engineers and technical people in the Cincinnati area to attend the A.S.T.M. session, planning for the joint buffet supper, at which there were a large number of A.S.T.M. members and committee people, attending to local publicity, arrangements for help at the registration desk and other such details. These men devoted considerable time to the meeting and they should receive full credit for this work.

Meeting with Technical Council of Cincinnati:

While Spring Meetings of the Society, Committee Week and even the Annual Meetings go on year after year, they are never mere functional repetitions. Last year in the Spring Meeting for example, there was the rather unusual

Technical Chairmen of the Symposium Sessions: J. H. Ingmanson and Simon Collier

situation of two technical symposiums on relatively new problems—Powder Metallurgy, and Paint, covering concealment, blackout and protective coatings—together with the first formal function of the newly organized Western New York-Ontario District Committee, an evening meeting—dinner and speaker. This year an unusual feature was the participation with the Cincinnati Technical and Scientific Societies Council at an evening meeting where Mr. J. L. Collyer, President, The B. F. Goodrich Co., spoke on "America's Rubber Outlook." Joining with him in the address was Dr. Waldo Semon, a leader in scientific developments involving synthetic rubber products. There were a large number of leading rubber technologists at the Taft Auditorium for the evening meeting which was the annual get-together of the Cincinnati Council. It is of interest to note that during the week of March 9, the Engineering Society of Cincinnati dedicated its new home. This Society with local sections of national societies forms the Council.

Through the courtesy of The Goodrich Co. there was a display of a number of interesting wartime applications of synthetic rubbers.

Because some of the information and data in the papers comprising the Symposium on The Applications of Synthetic Rubbers are of broad interest, and also to give members some idea of the nature of the papers which will be issued in complete form late in the spring, an attempt is made in the following pages to note some of the high lights.

The Origin and Development of Synthetic Rubbers (Harry L. Fisher)

While much has been achieved in synthesizing products, rubber has never been synthesized and consequently the term "synthetic rubber" is a misnomer, but since rubber is now also considered as the name of a type of material instead of only a chemical individual, its use is justified. A synthetic rubber may be defined as a substance that can be stretched to at least twice its original length and that after having been stretched returns to approximately its original length or position in a reasonable time.

Michael Faraday in 1826 helped to establish the fact that the chief constituent of rubber is a hydrocarbon. In 1860 Greville Williams isolated from the low boiling fraction a substance, C_5H_8, to which he gave the name isoprene.

In 1879 G. Bouchardat, by the action of HCl, polymerized isoprene to a rubber-like solid. From these beginnings, further research has led to the present large-scale production of rubber-like polymers, or "synthetic rubber."

The world production of crude rubber more than doubled from 1900 to 1910, being 44,131 long tons in 1900 and 94,013 in 1910, and the price had risen from an average of $0.98 a lb. in 1900 to the all-time high of $3.12 a lb. in 1910. In this same year metallic sodium, an important polymerizing agent, was discovered in England and in Germany. Thus the race for synthetic rubber was on.

The problem then and now is twofold. It consists of the preparation of the proper dienes and the polymerization of them to useful products. After the last war there was a lull in work on synthetic rubber. In the index of *Chemical Abstracts* for 1924 there is not a single item under that heading.

The author discusses and with flow diagrams shows how Koroseal, Neoprene, Buna-N, Butyl, and GR-S is made. He discusses the present Government program with a number of interesting tables, including those shown here.

SHOWING RAW MATERIALS NEEDED TO MAKE PRINCIPAL SYNTHETIC RUBBERS.

PETROLEUM	Butane or Butylene →		
NATURAL GAS	Butane →		
NATURAL GAS	Ethyl alcohol →	BUTADIENE	GR-S
POTATOES	Ethyl alcohol →		
GRAINS	Ethyl alcohol →		
SUGAR	Ethyl alcohol →		
MOLASSES	Ethyl alcohol →		
COAL TAR	Benzene →	STYRENE	
PETROLEUM	Benzene →		
PETROLEUM	Ethylene		
(SEE ABOVE)	(See above)	BUTADIENE	BUNA N
PETROLEUM	Ethylene →	ACRYLONITRILE	
AIR	Nitrogen →		
LIMESTONE, COKE, SALT, SULFURIC ACID		CHLOROPRENE-NEOPRENE	
NATURAL GAS	Isobutylene →		BUTYL
PETROLEUM	Isobutylene →		
(SEE ABOVE)	Butadiene or Isoprene →		

Harry L. Fisher, A. E. Juve, W. L. White, Leslie V. Cooper, and M. J. DeFrance

COMMERCIAL INTRODUCTION OF SYNTHETIC RUBBERS.

Type	Country	Year
Methyl rubber from 2,3-dimethyl-1,3-butadiene	Germany	1915
Neoprene (introduced as Duprene)	U.S.A.	1931
Thiokol	U.S.A.	1932
Butadiene rubber from butadiene obtained from alcohol	Russia	1932
AXF	U.S.A.	1934
Koroseal	U.S.A.	1935
Buna 85 and Buna 115, sodium polymers (never in large-scale production)	Germany	1935
Buna S and Perbunan (Buna N), emulsion polymers	Germany	1937
Vistanex	Germany	1938
Ameripol, Hycar, Chemigum, and Butyl	U.S.A.	1940
Norepol, Agripol	U.S.A.	1942

He concludes "research is the price of progress, and surely at this time, with the wonderful cooperation of rubber chemists and engineers, there can be expected marvelous advances in rubber technology that will make the synthetic rubbers do even more than natural rubber could do."

Physical Testing of Synthetic Rubber Products (L. V. Cooper)

An evaluation that will predict with a high degree of accuracy the suitability for service of any product is the object of all physical testing. Over 25 years, the rubber technologists have evolved a series of tests which have reasonably well evaluated natural rubber compounds. Although the background on rubber substitution is not extensive, A.S.T.M. Committee D-11 is able to present certain facts and recommendations to industry.

This paper deals with physical properties which affect the service of the product. The test engineer must often evaluate at higher or lower than normal testing temperatures. Ultimate tensile strength is not a satisfactory criterion of the quality of synthetic compounds. Tensile stress determination and the measurement of elongation at break can be obtained on the same test specimen while an ultimate tensile strength determination is being made (D 412 – 41) and these first two properties are of more value than the latter in judging quality. The only hardness determinations that can be relied upon at all with rubber are those similar to the standard A.S.T.M. method D 314 – 39.

A rebounding, swinging pendulum has been described which lends itself very nicely not only to resilience testing at normal temperature but also at elevated temperatures without too much modification. This is used in evaluating synthetic rubber compounds.

Various flexometers are employed primarily for a determination of the "heat build-up" characteristics. A definite amount of work is performed upon a block of vulcanized synthetic composition by distorting it a definite amount under a controlled compressive force. Some energy is transformed into heat during the process of absorbing and returning the energy. The amount of energy so transformed depends upon the resilience or efficiency of the compound.

One desirable characteristic of the synthetic rubbers is that air is usually less soluble in them than it is in natural rubber. Some day it may be possible to make inner tubes for tires which will retain air much more efficiently.

Adhesion is evaluated by the same procedure used for natural rubber, as given in D 429 – 39. A satisfactory laboratory method for evaluating resistance to cutting has never been developed. In resistance to tear, some synthetic rubbers are especially deficient. There is no one procedure for measuring this property. We have used a test consisting of stripping apart two slabs of rubber compound which are held together solely by means of connecting rubber fins formed when the slabs are vulcanized under pressure on opposite sides of a slotted metal insert.

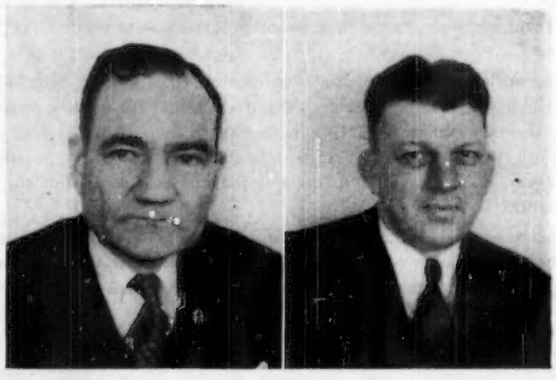
The aging characteristics differ from those of natural rubber. Present practice with synthetic rubber is to subject the vulcanized specimens to exposure in the standard air oven (D 573 – 42), except that the temperature is raised to 100 C. In the production of synthetic rubbers, it is necessary to introduce a material which will stop the polymerization and antioxidants are employed. Accelerated aging tests evaluate how effectively these function.

Few rubber technologists place any reliance on laboratory abrasion figures as an indication of service value.

No one realizes more than the rubber technologists how little we know about the synthetic rubbers on which we are now so dependent. In the present emergency we must push ahead in spite of this, and, at the same time, cooperate in our efforts to improve our knowledge of means for their evaluation. The statement is definitely as true today as it was the first time the expression was used—United We Stand and Divided We Fall.

The Physical Properties of the Synthetic Rubbers (J. M. Ball and G. C. Maassen)

This paper compares the synthetic rubbers with each other and with natural rubber as regards the physical properties of their vulcanized compounds. Data from numerous reliable sources were critically examined and correlated. No attempt is made to correlate the laboratory data with service life. Neither is there any implication that the exact values reported will be obtained on commercial rubber goods. The emphasis is on relativeness. No one of the synthetic rubbers possesses so many good properties as does natural rubber, but each of them is superior to rubber in one or more respects. *Editors Note:* In the accompanying tables there are presented examples of some of the voluminous data to be given in this paper. It is a most interesting technical contribution.



John M. Ball and G. C. Maassen

1943–1944 ESTIMATED QUARTERLY PRODUCTION* IN LONG TONS OF SYNTHETIC RUBBER FOR BUNA-S, BUTYL, NEOPRENE AND BUNA-N. (FROM H. L. FISHER)

	1943				Year Total	1944				Year Total
	1st	2nd	3rd	4th		1st	2nd	3rd	4th	
Buna-S	3 102	18 792	56 741	105 000	183 635	145 000	185 000	190 000	190 000	710 000
Butyl	35	393	364	1 500	2 292	4 000	6 000	12 000	17 000	39 000
Neoprene	4 372	5 853	10 049	12 300	32 574	12 300	12 300	12 300	12 300	49 200
Buna-N	2 977	3 335	4 063	4 500	14 875	5 000	5 000	5 000	5 000	20 000
Total Synthetic	10 846	28 373	71 217	123 300	233 376	166 300	208 300	219 300	224 300	818 200

* Includes Neoprene and Buna-N capacities of private plants.

THE ACCOMPANYING TABLES ARE COMPILED FROM MORE EXTENSIVE AND DETAILED TABLES INCLUDED IN THE PAPER BY MESSRS. BALL AND MAASSEN

Material	Gum Stocks		Channel Black Stocks		Channel Black Stocks			
					Heat Build-Up		Tear Resistance[a]	
	Tensile Strength, psi.	Elongation, per cent	Tensile Strength, psi.	Elongation, per cent	Percentage Rating Based on Temperature Rise	Qualitative Rating	Lb. per In.	Qualitative Rating
Natural rubber	2500–3500	750–850	3500–4500	550–650	100	A	650	A
GR-S (Buna S)	200– 300	400–600	2500–3500	500–600	75	B	250	C
GR-M (Neoprene)	3000–4000	800–900	3000–3500	500–600	90	A	450	B
GR-I (Butyl)	2500–3000	750–950	2500–3000	650–850	60	C	400	B
Buna N, H. A.	600– 900	500–700	4000–4500	500–650	75	B	300	C
Buna N, L. A.	500– 800	450–650	3000–3500	450–600	75	B	300	C
Thiokol FA	100– 200	450–550	1300–1700	600–700	70	C	250	C

[a] Methods are not standardized and they tend to give erratic results. The table is intended to bring out that apparently natural rubber is in a class by itself, that GR-M and GR-I are in a second class by themselves.

Material	Channel Black Stocks				Gum Stocks			Common Solvents for Cements
	Volume Change[a] (Sun Circo Light Process Oil 70 hrs. at 158 F.)		Sunlight Resistance	Flexing Life	Dielectric Constant			
	Percentage Rating	Qualitative Rating	Qualitative Rating	Qualitative Rating	Specific Inductive Capacity, 1000 Cycles Room Temperature	Percentage Rating	Qualitative Rating	
Natural rubber	100	C	B	A	2.69	100	A	Petroleum naphtha
GR-S (Buna S)	132	C	B	B	2.68	100	A	Aromatic petroleum solvents
GR-M (Neoprene)	254	B	A	A	6.70	40	B	Toluene or aromatic petroleum solvents
GR-I (Butyl)	69	C	A	A	2.32	116	A	Aliphatic petroleum naphtha
Buna N, H. A.	5500	A	C	B	5.58	48	B	Chlorotoluene, ethylene dichloride, nitroparaffins
Buna N, L. A.	1100	B	C	B	10.90	25	B	Toluene, xylene and/or methyl ethyl ketone
Thiokol FA	8300	A	A	B	7.10	38	B	Ethylene dichloride

[a] Care should be taken that the term "volume change" is not used as synonymous with the term "oil resistance," inasmuch as volume change is only one of many factors in oil resistance. More comparative data are needed on the important subject of oil and solvent resistance, properly defined.

Specifications for Synthetic Rubber Compounds (M. J. DeFrance)

Specifications for rubber compounds, either natural or synthetic, have been based on detailed requirements of the product and it is of utmost importance that the engineer recommending a product for any given application understand the details of the standard test procedures with relation to his immediate problem.

Practically every new application must be carefully examined for the relation between the conditions of performance and the standardized test procedures. Unnecessary requirements can cause a decrease in other qualities with a decrease in potential service life. A specification for synthetic rubber compounds should cover the requirements of the application involved—no more and no less. There have been innumerable specifications and, unfortunately for all concerned, there were almost as many compounds required as there were specifications. This condition of duplication became acute as synthetic rubbers began to replace natural rubbers.

As one remedy a tabulated system of standard physical properties for natural and synthetic rubber compounds has been developed, A.S.T.M. designation D 735 – 43 T. It was intended that they cover applications in the automotive and aeronautical fields.

This scheme of standardized physical properties with its five tabulations (which the author describes) practically covering the field of synthetic and natural rubber compounds offers an orderly approach to a large number of compounds with a wide variety of properties. It also provides a standardized grading system which as its use increases will result in speeding up the availability of the desired compounds. To the producer of the compounds it offers a method of standardization with the consequent simplification in factory production and laboratory testing. The economies thereby affected will accrue to the consumer as well as the producer.

The Processing Characteristics of the Synthetic Rubbers and Their Use in the Manufacture of Extruded Products (A. E. Juve)

All the synthetic rubbers in one respect or another are harder to process than natural rubber. The synthetics in general, differ from natural rubber in their susceptibility to softening by mastication and show a different relationship between nerve (tendency to recover after distortion) and plasticity.

An instrument found useful in studying the processing characteristics is the Mooney viscometer. This indicates the torque required to turn a

Stanton Glover, R. A. Schatzel, and Walter H. Juve

rotor at constant speed in a confined sample of elastomer at a constant temperature. Changes in viscosity with time, either toughening or softening, result which parallel under somewhat different conditions the changes which take place on a mill or in an internal mixer.

Of considerable importance is the degree of nerve present in the rubber before and after pigmentation. A test used is to masticate a fixed volume of rubber on a laboratory mill for a definite time at a constant roll temperature and mill opening. The rolls are then opened so that the bank just disappears, the rubber is cut off and allowed to shrink freely. The difference between the final length of the sample and the circumference of the roll is a measure of the nerve present.

Another property of importance is tack. No generally acceptable quantitative measurement has yet been evolved. Tack may be defined as that property which causes two layers of stock, which have been pressed together, to adhere so firmly that separation under force will occur at some point other than at the original two surfaces. If tearing such as this occurs, tack is rated as excellent. GR-M and GR-I have fair tack, and GR-S none. Compounding techniques will modify these ratings.

An extrusion plastometer developed at Goodrich which extrudes the material at constant pressure and constant temperature through dies of various shapes was used to determine the plasticity-temperature relationship of the pigmented stocks. Both GR-M and GR-I show a relatively greater increase in plasticity with temperature than natural rubber. GR-S is about the same as natural rubber.

Certain characteristics of the synthetic rubbers impose compounding limitations. In general, with GR-S, carbon blacks are the most satisfactory reinforcing pigments, but their use eliminates light colored compounds. While GR-M will produce pure gum stocks of excellent quality, they are excessively nervy. Pure gum stocks of GR-I are also excessively nervy. The principal compounding limitations for all the synthetic rubbers are in stocks in the low hardness range.

Intensive research is continuing on all the rubbers. Even without improvements in the crude materials, improved compounding techniques will solve many of the problems.

Synthetic Rubber Tires and Inner Tubes (P. M. Torrance)

This paper covers practical uses of synthetic rubbers in tires and inner tubes and gives the subject a general treatment. Not until after Pearl Harbor did anyone realize we were faced with practically complete replacement of natural rubber with synthetics. Complete cooperative effort was necessary. The major rubber companies organized a committee on compounding and use of synthetic rubbers under the auspices of the Rubber Reserve Co. Great progress was made. The Army Ordnance began large-scale testing of synthetic tires at Camp Normoyle, Texas, and Camp Seeley, Calif. These are the largest tire testing operations in history. The Synthetic Tire Construction Committee was later formed to correlate all development of synthetic rubber tires for both civilian and military use. This group has operated a fleet of 26 large commercial trucks testing tires from the 16 principal tire manufacturers. The Government Test Fleet was also started. This fleet runs tests on products of all manufacturers as well as special tests of interest to the Office of the Rubber Director.

The synthetic rubber passenger car tire is today a satisfactory product. At reasonable speeds it will deliver performance almost equal to the best prewar tire. The small civilian truck tires are reasonably satisfactory. Tread cracking, a most serious problem in highway tires, is not serious in Army tires due to the nondirectional cross bar design. The larger truck tires, 8.25-in. section and up, are still a most serious problem; total mileage expectancy of these synthetic rubber tires is increased threefold when loads are dropped to rated load from 30 per cent overload.

Excess heat causes premature fabric breaks and blowouts of synthetic rubber tires and also aggravates the other great weakness, its lower tear resistance. Rayon reduces the running temperature, making it equal to or lower than natural rubber. Rayon is now becoming available at such a rate that it is going hand in hand with the synthetic rubber conversion program.

P. M. Torrance

Overloads and high speeds must be eliminated in order to operate successfully on synthetic rubber tires. GR-S inner tubes are reasonably satisfactory, except for the smaller sizes used on drop center rims. Good progress has been made in the use of GR-S in solid tires. There are the difficulties of factory processing of synthetic rubbers, but the over-all average drop in capacity is not over 20 per cent. Additional facilities are being provided.

Chemical research will no doubt produce much better synthetic rubbers. Mother Nature, in creating the natural latex of the rubber tree, did not necessarily design the best possible material for tread wear, heat generation, and other desirable characteristics. There are numerous well-known examples of man-made synthetic products created for specific purposes which have far surpassed the natural materials previously used.

It is imperative that the rubber industry make every effort to develop superior synthetic rubbers, which can be produced economically, so that we will never again risk the disaster of being cut off from our sources of such a vital material as rubber.

Hose and Belting Made from Synthetic Rubber (W. L. White)

This paper reviews developments in the conversion from natural rubber to synthetic rubber in hose and belting.

Conveyor and Elevator Belts.—The user may expect Buna S (GR-S) belt covers to give quite good service in the carrying of such materials as sand and gravel, fine ores, trap rock up to 2 in. size, salt, sugar, etc., with some cutting and chipping when used for large size stone, ore, etc. Lack of resiliency of GR-S can be compensated some by using thicker covers than now permitted. With these and the improvements that can be expected, belt users should be pleased with the future performance of GR-S belts.

Neoprene (GR-M) belts can be recommended for the heaviest and most bruising types of service and where heat resistance is required. Care should be exercised with its use at low temperatures. More service history is needed to develop the economic value of the higher cost of GR-M belts as compared with the less expensive belts made from GR-S.

Flat Transmission Belts.—The best flex life for highest grade belts is with the use of GR-M. They should be used where oil is present, under elevated temperatures, for most severe flex conditions, and where long life is expected. GR-S belts can be used where flex conditions are not quite so severe. Their chief limitation is one of heat.

V-Belts.—GR-M will be used for special oil and heat-resisting purposes. It will probably replace the rubber belts operating near the top range of heat and will also replace belts which have maximum flexing. If belts operate at normal temperatures, then GR-S belts may be expected to give just as satisfactory life as have the "war" belts and will be much better than the all-reclaim belt.

Rubber and Synthetic Rubber Hose.—Water Hose—no difficulty is expected with water hose service if the proper selections of GR-S and reclaimed rubber are used.

Air Hose—should be made of GR-M to secure longest life. Where compressed air is relatively free from oil, and temperatures not excessive, then GR-S will make a very satisfactory hose.

Steam Hose—heat quite materially reduces the physical properties of GR-S, yet if proper strength members are employed then satisfactory hose can be made. GR-M has unfortunately more tendency to absorb hot water, and it seems questionable whether it will justify its higher cost.

Hoses to Carry Abrasive Materials.—GR-M possesses higher abrasive resistance, yet it is thought that GR-S will have sufficient resistance to prove its economical worth. Such hoses will have a short life if they are bent at too sharp a radius. More experience is needed.

How far and how fast we progress will depend upon the effectiveness of the united efforts of producers, consumers, and the users of these synthetic rubber products. Such industrial teamwork has and always will make our country a great industrial nation.

Synthetic Rubbers in Molded Products (Merle Sanger)

If we had been told seven months ago that we would soon be curing gas mask parts from Neoprene GN (GR-M) in the same cycles as rubber we would have had difficulty in believing it. Some of the problems and solutions are of interest. One difficulty was that of indecision by both civilian and military consumers as to the type of materials desired for their products and a solution, of course, is customer education. With better understanding, to be furthered by this Symposium, will come standardization and simplification of specifications. One of the most helpful steps would be the adoption of the A.S.T.M.-S.A.E. Rubber Compound Specifications (D 735).

Another problem was compounding limitations peculiar to synthetics, which has been solved by both individual and cooperative effort. An example was the series of technical meetings on gas masks and component parts. The molding of CWS faceblanks is one of the most difficult of any molded goods part—so the volume production of these parts is an outstanding tribute to the cooperative effort of American rubber technologists.

Metal adhesion was also found a problem. However, it was possible to utilize some techniques and adhesive materials that had been effective with natural rubber. Under proper conditions satisfactory adhesion results can be obtained with both GR-M and GR-S. However, the most satisfactory method of solving the problem with synthetic rubber is to design the part so that proper functioning does not depend on metal to rubber adhesion.

The author then lists nine questions which must be answered in analyzing a given application *and* discusses the properties of the synthetics—a most valuable part of the paper.

On the part that synthetics will play in the post-war picture of molded parts, special purpose synthetics are already firmly established in such parts as seals, diaphragms, gaskets, boots, and countless other parts. Present experience indicates that natural rubber will be substituted for the synthetic material when it is again available but where exceptional age resistance, heat resistance, weather or ozone resistance, flame resistance, and oil resistance are important the synthetics will continue to be preferred.

Cellular Rubbers (Louis P. Gould)

The nomenclature of these rubber products has not been too exact. There are patents entitled Froth, Expanded, and Cellular rubbers, all of which refer to the same product. Also, one patent named Cellular describes a product similar to that of another patent, Micro-porous. Our first problem then is to classify and define the various products.

Cellular rubbers have been divided according to cell structure of the finished products into three classes: Multi-cellular, with open cell structure; Uni-cellular, with closed cell structure; and Micro-cellular, with cells too small to be readily visible to the naked eye. Related products are impregnated fibers and cellular products made from materials other than rubber. Many products are made in soft and in hard rubber. Multi-cellular rubbers have been divided into Sponge and Latex Foam and Micro-cellular rubbers have been divided into Micro-porous and Multi-porous sheet rubbers.

Merle Sanger and Louis P. Gould

Sponge rubbers are made by incorporating into plasticized slab rubbers an inflating agent such as sodium bicarbonate together with proper vulcanizing ingredients, softeners, fillers, and age resisters. Many sponge rubber products must be put through mangles or wringer rolls to break up the closed cells and make them inter-communicating. Latex foam rubbers are ordinarily made by whipping air into rubber latices. The process is similar in some respects to beating up egg whites. Expanded rubbers with a closed-cell structure are made by subjecting the compound to a gas such as nitrogen under high pressures, semi-curing, allowing the mass to expand, and completing the cure.

Micro-porous rubbers are made by curing wet coagulums under conditions which will trap the water in the product during vulcanization. Multi-porous products, consisting of porous sheets made from latices, derive their porous characteristics from many minute and uniformly spaced holes that extend perpendicularly through the sheet. They are made by spreading latex on a pitted blanket. Air is trapped in each little pit. Heat is applied, and the air in the pits expands blowing little bubbles which burst and leave small holes in the film of rubber.

Sponge, latex foam, and expanded rubbers constitute by far the largest portion of cellular rubber production.

In the manufacture of sponge rubbers the following factors are important: Uncured mass must be plastic; rate of blow and rate of cure must be balanced; internal pressure must exceed the external pressure; rate of heat transfer is important; permeability of rubbers to various gases is important.

Present Status of Cellular Rubbers:

The information presented in this section is the result of a survey of the Cellular Rubber Industries; but the field is new and ideas are rapidly changing.

COMPARATIVE PROPERTIES—SPONGE RUBBERS

This assumes proper compounding for desired properties

Base Material	General Characteristics	Heat Resistance	Low-Temperature Compressibility	Swelling in Petroleum Base Oils	Flame Resistance	Compression Set
Natural rubber	Good	Good	Good	High	Burns	Excellent
Buna S	Good	Good	Good	High	Burns	Good
Buna N	Good	Good	Poor	Low	Burns	Good
Neoprene GN	Good	Good	Poor	Medium	Does not burn	Good
Neoprene FR	Good	Good	Good	Medium	Burns	Excellent
Butyl	Good	Fair	Fair	High	Burns	Fair
Plasticized Vinyl chlorides	Good	Poor*	Poor	Medium	Does not burn	Fair

* This is a thermoplastic and cannot be used at temperatures above 140 F

Latex Foam Rubbers.—In this field good results have been obtained with Neoprene GN latex. Aging properties are excellent and resistance to oil is superior to natural rubber latex. The unfavorable properties are shrink-

age and poor freeze resistance. The flame resistance of all types of Neoprene latex foam is especially important.

Expanded Rubbers.—In expanded rubbers, good products have been made from Butyl (GR-I), Neoprene GN (GR-M), Buna N, and Buna S (GR-S). Neoprene GN and Butyl rubber seem to give the best soft expanded rubber due to their relative impermeability to gases. Where resistance to aviation fuels is required Buna N is used. For water resistance, Butyl, Buna S, and Buna N are satisfactory but Neoprene GN is poor. For resistance to light aging and weathering enough experience would indicate that Buna N is better than Neoprene. Expanded soft rubbers act as admirable cushioning material since each cell encases a small amount of gas which must be deformed to absorb shock. The hard rubber expanded product is extremely light in weight yet has high tensile strength and is strong and durable.

Specifications.—During the past year a specification for cellular rubbers modeled after A.S T.M.-S.A.E. specifications for solid rubbers has been written at the request of the United States Army Ordnance Department. Load-deflection values are the basic requirement. Tests for oven aging, oil resistance, cold resistance, compression-set, water absorption, and flexing have been included as these seem to have important relation to performance characteristics.

Sponge Rubbers.—Sponge rubber products are being made from almost all types of synthetic rubbers. General purpose items are made from either Buna S or from Neoprene GN. General purpose applications of Buna S are: strip and sheet sponge, eye goggles, eye buffers for bomb sights, ramp-gate gaskets, and sealing strips. Buna N is used only where extremely low swelling in petroleum base oils is necessary and finds many uses in the aircraft, tank, and automotive industries. Neoprene GN (GR-M) will not support combustion and the sunlight resistance is very important. It is ideal for use as goggle frames, sweat bands, ear phones, etc. Plasticized vinyl chloride cellular products have good resilience, fair resistance to paraffin base oils, excellent resistance to almost all acids and corrosives, and excellent sunlight resistance, but they are thermoplastic and should be limited to temperatures between 0 and 140 F.

Hard Rubber Products from Synthetics (Walter H. Juve)

Since the start of the war the technologists of the hard rubber industry have been successful in making a conversion of 90 per cent of their products to synthetic rubber. Hard rubber is a highly vulcanized rubber containing a large proportion of sulfur. When a mixture of crude rubber and sulfur is heated a point of saturation is reached and there results pure ebonite (47 parts of sulfur are combined per 100 parts of rubber).

There are two types of the synthetic rubbers which can be satisfactorily vulcanized to hard rubber, namely, GR-S (Buna S) and Buna N.

As used in the industry, the term "hard rubber" generally means any hard or semi-hard vulcanized mixture with sulfur ratios ranging between 20 and 47 parts, in the case of natural rubber, and in synthetics ratios between 15 and 44.

Hard rubber dust has generally been recognized as one of the best fillers to use in hard rubber compounding and the industry has been able to develop a satisfactory quality of hard rubber dust made from GR-S.

Ebonites made from GR-S have physical and electrical properties which compare favorably with values for ebonites made with natural rubber. For example, here are some GR-S ebonite values—tensile strength, psi., 8800 to 9900; elongation, per cent, 4.2 to 8.5; transverse strength, psi., 13,400 to 14,700; impact resistance, Izod, ft-lb. (notched), 0.50 to 0.56; Rockwell hardness, 100 to 110; softening point, deg. Fahr., 144.

Excellent ebonites have been made from Buna-N compounds with better tensile strengths and softening temperatures than natural rubber ebonites, and these are used for a number of special applications.

Synthetic Rubbers in the Wire and Cable Industry (R. A. Schatzel)

Prior to the war rubber was the accepted standard insulation for power cable from low-voltage building wires to 33 kv. submarine cable, communication wire, and sheaths for portable cords and cables. Also, Neoprene sheaths and vinyl polymers (insulation and sheaths) had a considerable place despite their relatively higher cost, particularly for shipboard cable because they were superior in certain respects, chiefly in oil, flame, and oxidation, and sunlight resistance.

With conversion to synthetic rubber, and the necessity for cooperative development a legally sanctioned industry technical committee was formed. A most important phase of this work pertained to specifications and test methods, and the efforts of A.S.T.M. Committee D-11 in establishing emergency specification limits on compounds made from synthetics and lower percentages of natural rubber have been of great assistance. These A.S.T.M. emergency specifications have been recognized as standard by civilian industry and in the majority of cases by the Armed Services. They appear in all WPB orders. This has led to uniformity, simplicity, and speed in converting.

Note that early in 1943 the production of GR-S synthetic was negligible and by January, 1944, at least 80 per cent of the rubber used by the wire and cable industry was this synthetic material.

Processes involved in the manufacture of GR-S introduce constituents such as soap, salt, acid, and moisture which may have undesirable effects on the electrical properties. Considerable difference in the physical and electrical properties existed in lots from various plants, and so requests for concentrated production were granted that the cable industry receive the bulk of its GR-S from a single plant. Two other serious troubles involved rate of vulcanization and processing characteristics. These variations still occur even in the GR-S from the selected sources; the causes appear to be deep seated.

It is apparent from a comparison of the physical properties that GR-S compares very favorably with natural rubber in properties of importance in wire and cable applications. Service life is always of concern and since the aging properties of GR-S insulation are substantially superior to those of natural rubber insulations, the new insulations are expected to prove completely equivalent.

Electrical characteristics and performance of GR-S insulations may be considered equivalent to natural rubber, but certain electrical characteristics of GR-S are definitely inferior. Insulation resistance is only 10 to 30 per cent. Dielectric strength at temperatures in excess of operating conditions is lower. However, these play a very minor role in cable performance.

The use of Neoprene and vinyl polymer compounds for sheaths has been widely extended by the necessity of substitution. A great quantity of the vinyl polymer compounds have also been used as insulation. A.S.T.M. specifications ES – 28, ES – 30, and D 734 – 43 T have proved to be extremely useful in the conversion program and, by their existence along with the specifications for GR-S compounds, have permitted rapid change from one material to another depending on their availability. Butyl rubber has not been available in quantity, but the excellent dielectric properties and chemical inertness are well recognized. Practical problems of processing and vulcanization remain to be solved.

The physical properties and oil resistance of Buna N are exceptionally good and its use will increase as it becomes more readily available.

Use of Synthetic Rubber in Footwear (Stanton Glover)

Footwear is the parent rubber industry as shoes were the first commercial rubber products. Footwear plants have been allotted GR-S as a replacement for rubber. This discussion covers GR-S (Buna S), although GR-M Neoprene (GN) has been used in certain types of products. The GR-S compounds discussed are not particularly the best which could be developed, but the best which could be processed on a commercial basis. They can be substituted for rubber in footwear with at least equivalent quality as demonstrated by physical tests including tensile strength, abrasion, flexing, elasticity, and resistance to aging. The brittle point of GR-S is not quite as low as rubber, but satisfactory. In oil resistance, GR-S is considerably better. Practically all synthetic rubbers are better in skid resistance than natural rubber. Wear tests have proved their serviceability.

An appraisal of Mooney viscosity, grind and mix time (min.), shrinkage, building tack, and fusibility very definitely places GR-S on the de-

fensive as far as processing properties are concerned, and this constitutes the greatest difficulty in applying GR-S to footwear.

GR-S footwear compounds can best be made in black. This places a rather serious limitation on styling as it will be a serious objection after the war.

There is also the matter of material cost. Rubber may be compounded with cheap fillers, but GR-S must have expensive fillers to be comparable in quality.

Synthetic Rubber Adhesives (Fred J. Wehmer)

Fred J. Wehmer

The use of adhesives is no modern art. From time immemorial, people have desired to adhere one material to another by the easiest and cheapest method. Natural rubber was employed as an adhesive in some of its earliest practical applications. In 1823 Macintosh obtained a patent for rendering two fabrics waterproof by uniting them with a solution of rubber. They were called "Macintoshes."

Mention should be made of the tests by which synthetic rubber adhesives are evaluated.

(*a*) Adhesion should be measured in tension, shear, and by stripping before and after aging. It can be measured by pulling apart in tension blocks of material fastened together by the adhesive.

(*b*) Stability in viscosity is an indication of the useful life since adhesive which changes in viscosity with time will eventually fail to function properly. (A.S.T.M. Method D 553 is used.)

(*c*) Temperature resistance is indicated by change in strength when subjected to reduced or elevated temperatures.

(*d*) To use an adhesive, it must be applied by the methods usually available such as brushing, spreading, dipping, or spraying. Standard methods have not been developed but Committee D-11 is actively studying this problem.

(*e*) Tack retention or bonding range is measured by the time during which an adhesive retains sufficient tack or bonding power for use. This period starts when the adhesive has lost enough solvent so that it will hold together the materials to be bonded and terminates when it is so dry that an effective bond can no longer be made.

(*f*) Drying time is the period for an adhesive to lose its solvent.

GR-M (Neoprene GN) gives adhesives having properties most nearly comparable to those obtained with crude rubber.

These materials are successfully being used in many cases as substitutes for natural rubber. If we are willing to make use of the properties which these materials have, a new vista of usages will be opened. This will not come to pass, however, unless there is close cooperation between those who are using the adhesives and those who are attempting to make them.

TABLE I.

Type of Material	Tensile Before Aging	Tensile After Aging	Viscosity Stability	Temperature Resistance	Application Characteristics	Tack Retention Bonding Range
Reclaimed rubber-rosin	Good	Good	Good	Fair	Good	Good
GR-M (Neoprene GN)	Excellent	Excellent	Fair	Excellent	Fair	Good
GR-S (Buna S)	Good	Good	Good	Excellent	Fair	Good
GR-I (Butyl)	Fair	Fair	Fair	Poor	Fair	Fair
Thiokol	Poor	Poor	Excellent	Excellent	Fair	Poor

Two Latest Compilations of Standards

Two interesting special compilations of standards were issued late in February, these books providing all A.S.T.M. standards, with related information, on electrical insulating materials and on rubber products, being sponsored by Committees D-9 and D-11, respectively. While the compilations are not new from the standpoint that previous editions were issued in past years, each, of course, like all of these special compilations, differs considerably from its preceding edition. The compilation on rubber standards this year is particularly being greatly enlarged by the inclusion of a number of new specifications and tests relating to the field of rubber and rubber-like materials. This book also includes all of the Emergency Alternate Provisions which have been so widely used in conserving our supply of natural rubbers. This February, 1944, edition, with 434 pages, compares with the last edition of 300 pages. About one-third of the book is devoted to general methods of testing—chemical analysis, a large number of physical tests, many used in evaluating uses of rubber in important applications such as in liquids, resistance to light aging, tear resistance, etc. There are sections devoted to specifications and specific methods of testing rubber hose and belting, gloves, matting, insulated wire and cable, latex, rubber cements, sponge, and hard rubber products, with groups of tests and specifications on nonrigid plastics, and included for the first time are electrical tests involving dielectric strength, insulation resistance, power factor, etc.

Members can procure copies of this compilation at the special price of $1.50, the list price being $2.00.

The compilation on electrical insulating materials, first issued in 1927, has more than 75 specifications and tests covering various materials and products used in this field or relating directly thereto. There are a number of new standards developed and published for the first time in 1943. Eight standards cover various types of insulating varnishes, paints, lacquers, and their products. Sixty-five pages are devoted to the fifteen methods and specifications for molded insulating materials. A section on plates, sheets, tubes, and rods includes thirteen widely used standards. There are three standards on mineral oils and five relating to ceramic products (glass, porcelain, steatite). The seven standards covering various electrical tests comprise seventy pages. There are sections covering insulating paper, mica, and rubber products, textile materials, conditioning, enclosures, and servicing units.

An interesting part of the publication is the section giving references on significance of tests of various electrical insulating materials.

Complete with a 17-page subject index this 504-page publication can be obtained by members of the Society at the special price of $2.25, the list price being $2.75 per copy.

Many Technical Groups Meet During Committee Week, Reporting Important Actions

Numerous Meetings Held in Other Cities: Condensed Reports on Standardization and Research Activities Given Below

SINCE FEBRUARY 21 when Committees D-9 on Electrical Insulating Materials and D-20 on Plastics began a "pre-committee week" in Philadelphia, extending over four days, and through a period ending March 14 when D-12 on Soaps met in New York, there have been more than 218 meetings of A.S.T.M. standing committees including subcommittees, sections, and subgroups. This number gives some idea of the activity in the Society's technical work on materials and even disregarding the very considerable time spent in preparing for meetings it doesn't require an adult "Quiz Kid Joel Kupperman" to conclude that several thousand "A.S.T.M." man hours have been expended during these few weeks (total number of meetings × average duration × average attendance).

The committees were for the most part concentrating on their standardization work in order that the specifications and tests would be as up to date as possible for the 1944 Book of Standards, but aside from existing standards it will be noted from the statements that follow there are a great many new projects on which action is expected.

A.S.T.M. Committee Week at the Netherland Plaza, Cincinnati, extended over six days—Monday, February 28, through Saturday, March 4, with 148 meetings. A list of the main groups participating appears in the accompanying box.

Total registration for the week was 745, almost double the previous year, but it must be kept in mind that this attendance varies considerably depending upon the number of committees participating—more committees, more registration. All of the meetings were well attended; in fact, a very noticeable trend of the past year or two, continued, by which many of the subcommittees had almost as many present as at the main committees; several subcommittees had an attendance of 60 to 75. There were a very considerable number of visitors present as guests of committee members or members of the Society in the Cincinnati area who were not active in committee work, but took advantage of the meetings to sit in meetings on those subjects with which they were concerned.

Members and others concerned with specific committee work may find the statements which follow of interest and indicative of some of the major actions expected. For the most part, all of the recommendations will be referred by the committees to letter ballot for approval before recommendation to the Society. This situation should be kept in mind in reviewing the proposed actions on standards and tentative standards. The material, much of which has been obtained from statements received from committee officers, in one sense affords a preview, even if somewhat sketchy, of annual reports. Also there will be distributed to members and committee members early in May copies of the Provisional Program for the Annual Meeting which will carry, as is customary, synopses of committee reports and technical papers. Finally, preprints of most reports and technical papers will be distributed in advance of the annual meeting on request. Some departure from the method of preprinting reports has been considered by the Committee on Papers and Publications on which a further statement will be made.

List of Committee Meetings

This list includes not only committees meeting in Cincinnati during the 1944 Committee Week, but other groups which convened recently. Unless noted, the meetings were in Cincinnati. Statements of important actions at many of these meetings appear on the accompanying pages.

A-1 on Steel
A-3 on Cast Iron
A-5 on Corrosion of Iron and Steel
A-6 on Magnetic Properties
A-7 on Malleable Iron Castings
A-10 on Iron-Chromium, Iron-Chromium Nickel and Related Alloys
B-3 on Corrosion of Non-Ferrous Metals and Alloys
B-5 on Copper and Copper Alloys
B-6 on Die-Cast Metals and Alloys
B-7 on Light Metals and Alloys
B-8 on Electrodeposited Metallic Coatings
C-1 on Cement (Allentown, Pa., March 3, 4)
C-16 on Thermal Insulating Materials
D-1 on Paint, Varnish and Related Products
D-2 on Petroleum Products and Lubricants
D-4 on Road and Paving Materials
D-5 on Coal and Coke
D-9 on Electrical Insulating Materials (Philadelphia, Pa., Feb. 21, 22)
D-11 on Rubber Products
D-12 on Soaps and Other Detergents (New York, N. Y., March 13, 14)
D-13 on Textile Materials (New York, N. Y., March 8–10)
D-17 on Naval Stores
D-20 on Plastics (Philadelphia, Pa., Feb. 23, 24)
Joint Committee on Spectrophotometry (E-2, E-3)
Subcommittees of E-3 on Chemical Analysis of Metals
Subcommittees of E-4 on Metallography

Steel

At well attended meetings of Committee A-1 on Steel detailed consideration was given to many of the 130 specifications in the charge of this group and several new activities were outlined. Several specifications for structural steel were reaffirmed and the renewal of studies on a specification for structural weldable steel for bridges and buildings was authorized.

Consideration of the desirability of setting up a maximum carbon limitation on certain types of ring and disk forgings, specifications A 243, when used for welding resulted in no action, leaving decision on this matter to governing codes. Of direct interest in this field is the development of two new specifications giving up-to-date requirements for carbon and alloy blooms, billets, and slabs for reforging purposes which would include all of the widely used carbon and alloy grades, provide for agreement on ranges in chemistry and variations where special grades are required, and also provide for the invoking of a number of extra quality tests if desired by the purchaser—special finish, magnetic particle tests, etc.

As a tentative revision certain new grades will be proposed in the specifications covering alloy-steel forgings of the quenched and tempered class for industrial use with physical properties (depending on size classification) ranging from 135,000 to 170,000 psi. tensile strength, and elongations in 2 in. from 11 to 15 per cent.

There was, as usual, considerable activity in the field of pipe and tubing with provisions being established in the widely used pipe specifications A 53 permitting purchase of electric-resistance-welded pipe in $^1/_8$- and $^1/_4$-in. sizes. No tensile requirements would be required. There would be limitations on carbon and other provisions would be met.

In cooperation with Committee A-10 on Iron-Chromium and Related Alloys a joint subcommittee has been reviewing proposed specifications for corrosion-resisting pressure *tubing* for service in cracking stills, dairy and food industries, and for general purpose use, the latter involving both the austenitic and ferritic grades. Another problem is to bring existing chemical requirements on austenitic steel *pipe* in line with the current supply situation and this problem was referred to the joint subcommittee for recommendations.

Because of the disproportionate "necking down" of the 8-in. specimens used in determining tensile properties of certain alloy-steel plates for use in boilers and pressure vessels, difficulty has been obtained in certain provisions. As a result, changes are in process which would provide that for plates $^3/_8$ to $^3/_4$ in. thick if the percentage of elongation of an 8-in. gage length test specimen falls not more than 3 per cent below the amount prescribed, the elongation shall be considered satisfactory if percentage in 2 in. across the break is not less than 30. This provision will take care of the decrease in percentage of elongation which results as the gage length is increased.

In the field of castings for fusion welding for service at elevated temperatures the effect of stray elements was discussed in detail, but the committee will study the matter further. An emergency provision will be carried through setting up a grade of steel casting in the carbon steel class for high-temperature service (A 95) of 65,000 psi. for tensile strength. Chemistry provisions in the widely used chromium-molybdenum bolting grade B7 (A 193) are to be modified to be brought in line with current practice.

Because of the incorporation of many of the A.S.T.M. steel specifications in the WPB Limitation Order L211, and the present war situation, the large number of emergency alternate provisions which have been established to expedite procurement or conserve certain materials are, in general, being continued.

Cast Iron

Items of particular interest covered at the Cincinnati meeting of Committee A-3 on Cast Iron included the status of pig iron specifications, a complete review of specifications on various types of iron castings in the province of the committee, consideration of magnetic particle testing, and interesting discussions on use of gray iron at supernormal temperatures.

Recently Subcommittee I on Pig Iron has been reconstituted under the chairmanship of H. W. Stuart and major types of consumers with leading producers and general interest groups are serving. The status of specifications was reviewed and firm foundations established for useful and equitable consumer-producer specifications. Proposed standards are being drafted.

Committee A-3 has several important specifications for castings, one in particular being widely applied, a 48 for gray iron castings with its seven classes of material ranging from 20,000 to 60,000 psi. minimum tensile strength. Others cover material for valves and fittings (A 126), automotive (A 159), pit-cast pipe (A 44), and lightweight and thin-sectioned (A 190). After study, it was decided no major changes were necessary but some information and data may be added as appendices to certain of the standards in order to enhance their usefulness.

It has not been necessary to issue emergency cast iron specifications. One reason for this is that all these specifications are based primarily on mechanical properties where engineering applications are a consideration.

In the field of cast iron, magnetic particle testing is of increasing interest, and the committee plans to join with other A.S.T.M. study groups in evaluating various methods of application, interpretation, etc.

Gray Iron at Elevated Temperatures:

Subcommittee XXII which has been developing data on the use of gray iron at elevated temperatures has held several interesting discussions on this problem. In Cincinnati it considered details of proposed specification requirements for gray iron for service up to 650 F., as pressure containing parts. Improvements were agreed on in defining the requirements and in eliminating intermediate temperature levels below 650 F. As drafted, the proposal avoids conflict with other A.S.T.M. specifications, for example, with requirements for Gray Iron Castings for Valves, Flanges and Pipe Fittings (A 126 – 42) which are now used up to 450 F. in accordance with existing codes.

A new limitation on the composition of the cast iron for elevated temperature work was proposed by defining the carbon equivalent, namely, C + 0.3 (Si + P) shall equal not more than 3.8. Cast irons above the grade of No. 40 (40,000 psi. tensile) were to be eligible for this service, and existing cast irons up to the grade of No. 40 are at present eligible for service up to 450 F. in existing pressure vessel codes. A further requirement proposes that all castings must be stress relief annealed by heating above 900 F. and not more than 1050 F. Plans are in motion to redraft the proposed specification, support its contents with references and explanatory paragraphs and present it for approval.

Corrosion of Iron and Steel

Based on considerable discussion and study by the subcommittee in charge, Committee A-5 on Corrosion of Iron and Steel approved for submission as emergency specifications requirements covering lead-coated alloy sheet. Following favorable letter ballot in the subcommittee and approval by the main committee chairman they will be referred to A.S.T.M. Committee E-10 on Standards.

It was announced that additional failures had been observed of certain of the specimens in the atmospheric corrosion tests of copper and noncopper-bearing sheets at Annapolis, some of these specimens having been on exposure for 30 years.

Careful reviews were made by the committee of its numerous specifications, most of which are to remain unchanged for inclusion in the 1944 Book of A.S.T.M. Standards. Some of these specifications cover zinc-coated barbed wire, and field and railroad fencing; zinc-coated wire strand with various coating grades; telephone and telegraph line wire and tie wires; also the zinc-coated sheet requirements and the standard for zinc coatings on iron and steel hardware.

An interesting outline of field conformance tests was given, one of the objectives being eventually to be able to correlate laboratory and field tests. This is a most perplexing and involved problem, but progress is anticipated. A magnetic test of coating it is hoped can be recommended as a field test and a continuity test which may be based on the so-called Hermance procedure is being evaluated which, however, would probably not fulfill the requirements of a field test. The use of the microscope is being studied. Reference was made to the paper in the March 1942 ASTM BULLETIN covering dropping test for zinc and cadmium coatings, including discussion on magnetic and other procedures.

Magnetic Properties

GOOD PROGRESS was reported by the subcommittee on nomenclature and definitions of Committee A-6 on Magnetic Properties in connection with the glossary of terms relating to magnetic testing which is being prepared to supersede standard definitions A 127 – 41. It is hoped that this project can be completed in time to be included as a tentative standard in the 1944 Book of Standards.

In the work on direct current test methods the procedures for determining permeability of feebly magnetic materials (A 259) first issued in 1942 (revised last year) as a tentative standard, is considered satisfactory for adoption and it will be so recommended to become part of the standard A 34, the general test methods for magnetic properties of iron and steel. This standard covers the use of both direct and alternating current methods and in connection with the latter certain clarifying notes are to be added to the section on lamination resistance and further modifications will involve a rearrangement of the section on core loss to make the test at 15 kilogausses the standard test, with a test at 10 kilogausses an approved alternative. Finally, in addition to A 259 mentioned above, two other tentative methods covering permeability and core loss of flat-rolled magnetic materials using 28-cm. specimen (A 257) and normal and incremental permeability (A 258) are to be submitted for adoption and incorporation in A 234.

Work on frequencies higher than 60 cycles was reviewed with encouraging results.

Malleable-Iron Castings

A development that will be of widespread interest to users of malleable iron castings was announced at the meeting of Committee A-7, involving proposed specifications for pearlitic malleable iron castings. This proposed standard which will be offered for approval as tentative in 1944, provides for physical properties which will be readily obtainable under current manufacturing conditions, with a special class "X" not covered in the so-called regular class. Properties of this particular grade would be subject to agreement by the manufacturer and purchaser.

The committee discussed the application of its various standard requirements and concluded that they were being widely used. There had been some question in connection with grade 35018 which calls for a minimum tensile strength of 53,000 psi., a 35,000 psi. yield point, with an 18 per cent minimum elongation in 2 in., but discussion indicated that this grade was being regularly produced by a number of foundries.

The repair welding of malleable iron is a subject of interest because it is permitted by some agencies, and to get a clearer picture of what is involved, a study committee has been established.

In discussion of the work of Committee A-7, it was concluded that there had been close cooperation between committee members and various Government agencies in agreeing on the various standards.

Iron-Chromium-Nickel and Related Alloys

Perhaps the most interesting item discussed by Committee A-10 on Iron-Chromium-Nickel and Related Alloys was the preliminary outline of the extensive new program of atmospheric exposure tests. The plan is to use various chemical compositions in different mechanical forms, exposing to three types of atmosphere for periods up to 15 years. Some details appear below.

In the Boiling Nitric Acid Test (A 262), it was decided to retain the c. p. grade of acid and to establish a requirement on the volume to be used per unit area of specimen, namely, 125 ml. minimum per square inch of surface area. Also, where agreed on by the manufacturer and purchaser three periods of boiling time will be accepted in lieu of five, the present requirement.

The committee plans to include further restrictions on testing of certain materials involving speed of test which will be limited to $^1/_8$ to $^1/_2$ in. per minute for austenitic grades. A series of round-robin tests will involve sample preparation, particularly edge preparations.

Drafts of new standard specifications are nearing com-

(For notes on other technical Committees turn to p. 46)

A Colorimetric Method for Determining the Water Vapor Content in Fuel Gases, Utilizing the Evelyn Colorimeter*

By R. J. Pfister[1] and D. J. Kerley[2]

SYNOPSIS

A technique is described for determining moisture in fuel gases, using the Evelyn photoelectric colorimeter. The analysis requires a sample of condensate frozen out at −70 C. from a measured volume of gas. By trial or by experience enough gas is sampled to yield about 1/4 g. of water. The increase in weight of the absorption tube after warming and venting to the atmosphere gives, after deduction for its approximate water content, the nonaqueous diluent present in the sample. To this condensate 25 ml. of water indicator solution (0.1 per cent cobaltous bromide in butanol) are added and the transmission is read in the Evelyn colorimeter at 74.0 F., using the 660 mμ band filter. Three calibration graphs are used. First, one to correct, if necessary, the transmission of the indicator solution for a slight deviation in temperature from the standard operating temperature of 74.0 F.; second, one to correct the transmission of the indicator solution for nonaqueous condensate as indicated by the total weight of condensate; third, one to convert the corrected transmission to water content of the gas sampled. Results from both field and laboratory tests indicate that water contents may be determined to within ±3 per cent of the absolute value of the moisture present.

FOR CONTINUOUS and economic operation of fuel gas lines, especially those operated under high pressures and in regions of severe temperature changes, an accurate knowledge of the absolute water vapor content of the gas is of paramount importance. Such information, when dependable, makes it possible to maintain gas lines under continuous operation and at their maximum efficiency, and also to prolong their economic life materially. The lack of this information leads to serious operational difficulties persisting, in many instances, over long periods of time after the cause has been eliminated. These difficulties are:

1. Reduction in carrying capacity of the line or stoppage of the gas flow completely as a result of hydrate formation or actual freezing of condensed water.
2. Interference resulting from the transportation of dust and products of corrosion to points of accumulation where they are likely to interfere with the passage of the gas through the line.
3. Changes in meter proofs resulting from alternating wet and dry diaphragms.

These difficulties may be eliminated by close control of the water vapor in the gas. Hydrates cannot form in the absence of liquid water. Also, liquid water greatly accelerates corrosion rates, which not only shortens the life of the equipment but also releases corrosion products. Dust troubles are minimized by maintaining the water content above a certain minimum. In addition to increased dust interference due to excessive drying of the gas, the cost of removing the last traces of water vapor becomes appreciable and tends to make the operation uneconomical.

Various possible methods of measurement of water vapor content of gases are available, including weighing the water separated in an absorption tube, reacting the water with some chemical to produce a measurable by-product, the use of a hair hygrometer, the use of wet and dry bulb thermometers and humidity charts, thermal conductivity of the gas, and the dew-point method. Each of these methods has certain limitations which made it desirable to investigate a new method. The direct weighing of the absorbed water usually includes more than the water alone. The chemical reaction with water has not been completely tested to insure freedom from interfering reactions for analytical purposes. The hair hygrometer needs frequent checking and is not accurate over too great a range. The wet and dry bulb thermometers are not always convenient to use and the gas velocity past the thermometers must be carefully regulated. The thermal conductivity method is sensitive to changes in gas composition other than water content and, therefore, the results must be interpreted with care. The dew-point method is perhaps the most common, but it, too, must be used with care lest the condensation of some film other than water is misinterpreted for moisture.

A colorimetric method for determining the water content of gases has been described by Todd and Gauger[3] which utilizes the change in transmission produced in an 0.1 per cent solution of cobaltous bromide in butanol. Certain troublesome features with the apparatus and the technique made it desirable to try a simpler method. The Evelyn colorimeter (manufactured by the Rubicon Co., Philadelphia, Pa.) has proved to be a satisfactory instrument (see Fig. 1). Its small light source causes a minimum temperature drift in the solution. The measurement of percentage water content is made with the Evelyn color filter No. 660 which transmits a wave length band between 635 and 720 mμ and has a maximum at 660 mμ.

Preparation of Water Indicator Solution and Calibration of Evelyn Colorimeter

The water indicator solution was prepared by dissolving 10 g. of cobaltous bromide (c. p. $CoBr_2$) per liter of butanol (commercial grade). To avoid restandardization, enough of this solution was prepared to make all the calibrations and to leave enough solution for analytical tests. The original 0.1 per cent cobaltous bromide solution is taken for the zero water content standard. The highest water contents examined contain approximately 2 per cent water in the indicator solution. This reference standard is made by adding 4 ml. of water, delivered from a calibrated

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[3] F. C. Todd and A. W. Gauger, "Studies on the Measurement of Water Vapor in Gases," *Proceedings*, Am. Soc. Testing Mats., Vol. 41, p. 1134 (1941).

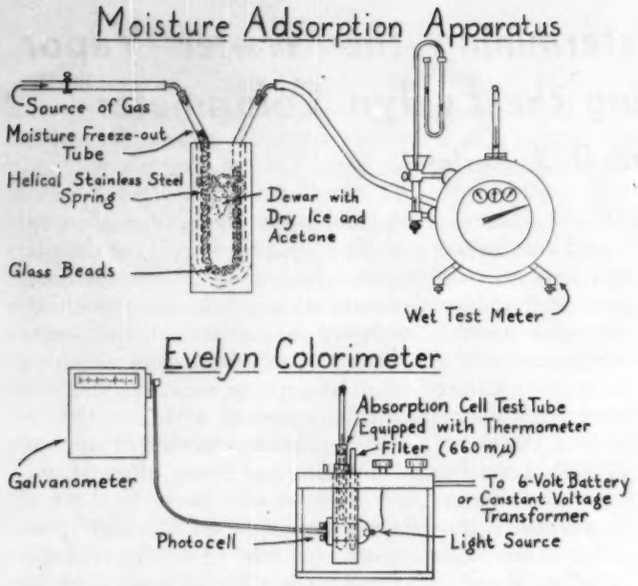

Fig. 1.—Diagram of Apparatus for Collecting Moisture from Gas and for Its Measurement in the Evelyn Colorimeter.

pipette, to 200 ml. of the indicator solution. From the standards containing 0 and 2 per cent water in the indicator solution, intermediate concentrations are made by mixing the following fixed volumes measured from pipettes:

Volume of Standard Solution Containing 2 per cent Water, ml.	Volume of Standard Solution Containing 0 per cent Water, ml.	Water in Resulting Standard Solution, per cent
45	5	1.8
40	10	1.6
35	15	1.4
30	20	1.2
25	25	1.0
20	30	0.8
15	35	0.6

The percentage of transmission at 660 mμ of each of these solutions was then read at various temperatures between 71 and 76 F., using the Evelyn colorimeter. To permit accurate temperature measurement, a short thermometer calibrated between 68 and 88 F. in 0.2-deg. divisions is equipped with a one-hole stopper to fit in the Evelyn test tube absorption cell. The bulb of the thermometer is adjusted to be just above the light path when the tube is in the colorimeter. This permits reading the temperature at the time the measurement of transmission is made. The solution to be examined may be adjusted to a selected temperature by dipping the tube in beakers of warm or cold water. The tube is wiped with a clean cloth and vigorously shaken before reading the temperature, and the temperature is checked immediately after reading the transmission so that the average temperature is recorded in case of a slight temperature drift.

To spread the transmission measurements over as many scale divisions as possible, a special blank solution of dilute copper sulfate is used to set the full scale (or 100 per cent transmission) calibration of the instrument. Since the highest water content to be measured has a high transmission but still shows considerable absorption when compared to distilled water, a colored blank solution is used to set the full scale deflection of the colorimeter. For convenience and stability, a copper sulfate solution is made up to be just strong enough so that when its transmission at 660 mμ is made to read 100, the air reading with the

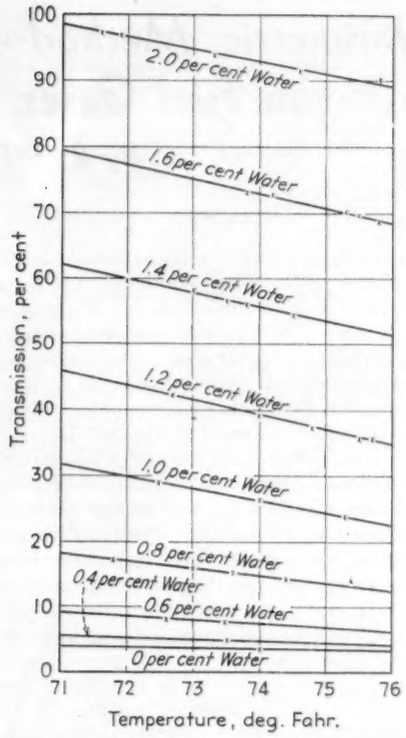

Fig. 2.—Calibration Curves Showing the Effect of Temperature on the Percentage Transmission at 660 mμ for Indicator Solutions of Various Water Contents.

tube of copper sulfate removed will be between 98 and 100. The lower reading through air than through the tube of copper sulfate solution is due to the lens effect of the ab-

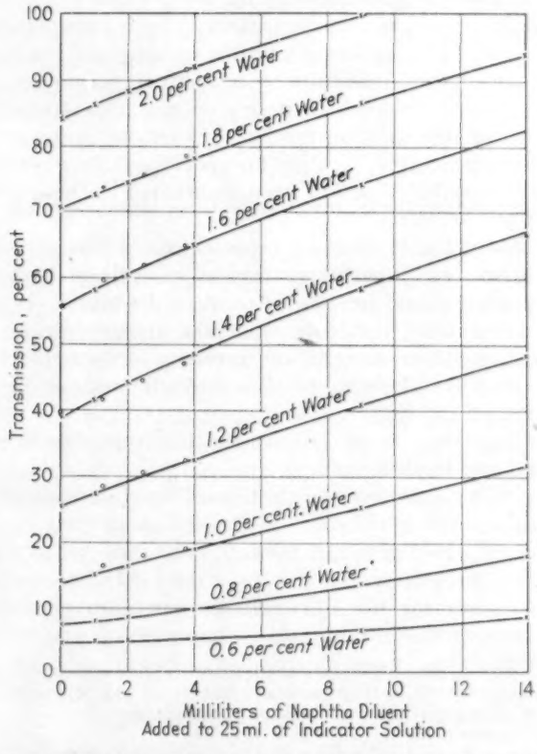

Fig. 3.—Calibration Curves Showing the Effect of Dilution with Naphtha on the Percentage Transmission at 660 mμ for Indicator Solutions at 74.0 F. with Various Water Contents.

sorption cell test tube. The exact value of this air reading may be used as a secondary standard for checking the full scale deflection setting over a period of 15 or 20 min., during which time the colorimeter has not been disturbed. Since the air value is regarded only as a secondary standard, its value should be checked from time to time by the use of the standard copper sulfate blank solution.

As an additional precaution to secure reproducible results with the Evelyn colorimeter, only two of the selected test tube-type absorption cells were used. One was marked No. 1 and contained only the copper sulfate solution, while the other, marked No. 2, was used exclusively for the indicator solutions. Both tubes were marked with a vertical scratch near the top so that they could always be oriented in the same way when placed in the colorimeter.

The power for the colorimeter lamp was furnished by a 6-v., constant voltage transformer rather than from a 6-v. automotive storage battery. This was found more convenient and steadier where a regulated 60-cycle frequency was available.

To facilitate carrying one solution to measure two dependent variables, namely, temperature and dilution with naphtha, the following procedure was used. A 25-ml. sample of indicator solution of fixed water content is measured into the absorption test tube by means of a pipette. The measurements of transmission are made at several temperatures between 71 and 76 F., and each measurement is recorded with the corresponding temperature within 0.1 F. The sample is then diluted with 1 ml. of water-white naptha, delivered from a pipette, and after shaking and adjusting the temperature to as near 74.0 F. as possible, the transmission of this dilution is determined. Then a second 1-ml. portion of naphtha is added and the transmission is again measured. Subsequently 2, 5, and another 5 ml. of naphtha are added. From these data the effect of 1, 2, 4, 9, and 14 ml. of naphtha per 25 ml. of indicator solution with known water content is plotted (see Fig. 2). In turn, each of the other reference standards representing 2.0, 1.8, 1.6, 1.4, 1.2, 1.0, 0.8 and 0.6 per cent water, respectively, are first examined for temperature effect and then for dilution effect. The resulting data are plotted as families of curves, each for fixed known water contents, on two graphs: one relating to temperature (Fig. 2) and the other relating to dilution (Fig. 3), and each showing percentage transmission.

From the graph of temperature *versus* percentage transmission, the main curve is constructed which relates percentage transmission at 74.0 F. with concentration of water when no diluents are present in the indicator solution. All these graphs are constructed on linear scales because, in this case, the familiar Beer's law relation is not applicable and the semilogarithmic plots are no nearer a straight line than the more conveniently read linear plots. The three charts furnish complete calibration data of the colorimeter and the indicator solutions for analyzing the water content in the condensate obtained from measured gas samples.

Procedure Used for Determining Water in Gas Samples

The freezing tube for collecting the moisture from a measured volume of gas consisted of a glass U-tube made of 1.7-cm. Pyrex tubing with legs of the U about 30 cm. long and bent so as to fit inside a quart Dewar flask. The gas entered the U through one leg occupied by two pieces of helical stainless steel springs and left through the other leg which was filled with glass beads and a cotton plug. Two U-tubes were usually immersed in the same Dewar flask, which was nearly filled with a mixture of dry ice and acetone. Thus two volumes of gas from which the moisture had been removed were measured by two wet test meters simultaneously.

Gases containing no condensables other than water are most readily analyzed because they involve no dilution correction. The method is simply to pass enough of a measured volume of the gas through a suitable freezing tube to collect about $^1/_4$ g. of water. The condensate is allowed to warm to room temperature, taking care by slight venting that only a negligible amount of the water is lost by evaporation. Then a measured volume, usually 25 ml. of the indicator solution,[4] is added to the condensate and thoroughly mixed. The mixing in the U-type freezing tube may be accomplished by tightly stoppering both arms of the tube and shaking so vigorously as to knock the beads alternately and repeatedly against the stopper and the bend in the tube. The shaking should be so thorough that complete mixing as indicated by a uniform color in the cotton wad is also effected. The indicator solution may then be poured into the absorption test tube, the temperature adjusted to 74.0 F., and the percentage transmission read as previously indicated. Since no dilution is present, the water content may be read either as percentage water in the indicator solution or as gallons of liquid water per million cubic feet of gas. In using the second units, the calibration chart reads gallons of water per million cubic feet of gas directly only if 10 cu. ft. of gas are sampled and 25 ml. of indicator solution are added; otherwise, appropriate correction must be made.

To analyze gas containing condensables other than water, the procedure is similar to that already described, except that an estimate of the volume of diluent is obtained and the appropriate correction made according to the graph showing the effect of various volumes of diluent on the percentage transmission of the indicator. To obtain a measure of the amount of diluent, the freezing tube is weighed to 0.1 g. or better[5] before and after collecting the sample of the condensate. The difference in weight will be the amount of water plus hydrocarbon and other condensables with a boiling point of about 10 C. or above, since, as indicated above, the sample of the condensate is collected and allowed to warm up to room temperature while it is carefully vented. This procedure will allow most of the very volatile condensables to escape before the condensate is weighed, thus stabilizing the dilution effect and keeping it at a minimum. The volume of the diluent is determined by dividing the observed weight of condensate by its density. A density of 0.67 determined from a sample collected from natural gas containing gasoline vapor is used for all the results reported in this paper. The weight and volume of water in the condensate may be disregarded, because in cases where the nonaqueous condensate is small the dilution correction is small, and where condensate other than water is large, the error in estimating the volume of this condensate will usually be small

[4] If too small an amount of water is collected, for example, 0.15 g. or less, it is desirable to add only 15 ml. of indicator solution and then correct the result accordingly.

[5] Preferably on a good, triple-beam, platform balance.

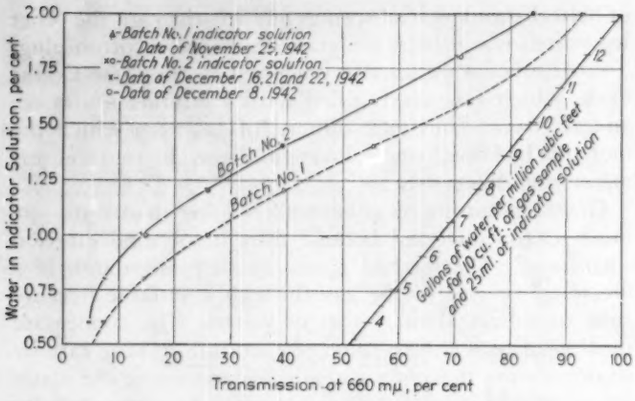

Fig. 4.—Calibration Curves for the Water Content *versus* Percentage Transmission at 660 mμ of Two Batches of Cobaltous Bromide Indicator Solutions at 74.0 F.

even when the amount of water is disregarded.[6] While it would be desirable to estimate the condensables directly by a volume method, no convenient procedure could be devised. A method similar to that published by Todd and Gauger,[3] based on a measurement of the effect of a diluent on the transmission of the indicator solution (at about 440 mμ), was found to be unreliable, since the transmission at this wave length did not change significantly (in a 1-cm. depth) with addition of naphtha as a diluent for the indicator solution.

The method for determining the water content of a gas sample can perhaps best be illustrated by giving a sample calculation. Sample No. 12 shown in Table I requires three important corrections: (1) for nonaqueous condensate, (2) for volume of indicator solution used, and (3) for volume of gas sampled. Since the indicator solution was adjusted to the exact standard reference temperature, no correction was required for the effect of this variable on the percentage transmission.

The data for sample No. 12 are: 5.00 cu. ft. of gas sampled, 4.8 g. of condensate mixed with 15 ml. of indicator solution, and 51.6 per cent transmission of the solution at 74.0 F.

It is necessary to estimate the volume of condensate per 25 ml. of indicator solution so that the effect of dilution on percentage transmission may be determined by use of Fig. 3. Thus,

$$\frac{4.8 \text{ g.}}{0.67 \text{ g. per ml.}} \times \frac{25}{15} = 12 \text{ ml. dilution per 25 ml. of indicator solution}$$

By reference to the appropriate transmission line at 12 ml. dilution in Fig. 3, it may be seen that 51.6 per cent transmission corresponds to 29.5 per cent transmission if the condensate contained only water. (This large correction is the result of the sample containing almost 20 times as much nonaqueous condensate as water.)

By reference to Fig. 4, it may be seen that 29.5 per cent transmission of indicator solution No. 2 corresponds to a water content of 8.3 gal. per million cu. ft., but this is for 10 cu. ft. of gas sampled and 25 ml. of indicator added to the condensate. Since in this instance only 5 cu. ft. of gas were sampled, the water which would be found in a 10-cu. ft. sample would be twice as great, but if 25 ml. of indicator would have been added the water content would have appeared smaller in the ratio of 15/25. Making these corrections, the final result is obtained:

$$8.3 \text{ gal. per million cu. ft} \times \frac{10}{5} \times \frac{15}{25} = 10.0 \text{ gal. of water per million cu. ft.}$$

Since no drying tube was used to check the water content of the gas at this time, the above result can only be compared for reproducibility with the results of samples Nos. 13 and 14 which were collected simultaneously and immediately after sample No. 12.

[6] A correction for the approximate amount of water on the volume of the condensate could be made, but the over-all reproducibility of the analysis does not warrant it.

TABLE I.—RESULTS OF THE COLORIMETRIC DETERMINATION OF WATER VAPOR IN AIR AND IN MANUFACTURED GAS.

Indicator solution batch No. 1 used for samples Nos. 1 to 11. Indicator solution batch No. 2 used for samples Nos. 12 to 16.

Sample[a]	Volume of Gas Sampled, cu. ft.	Diluent: Grams	Diluent: Milliliters[b] per 25 ml.	Volume of Indicator Solution, ml.	Transmission: Measured at 74.0 F.	Transmission: Corrected for Dilution	Water Content, gal. per million cu. ft.: Indicated on Graph	Drying Tube Results	Colorimeter Results	Deviation, per cent	Average Deviation, per cent
Samples of Air Saturated at 20 C.											
No. 1	0.8	0	0	25	65.0	..	10.0	124[c]	125	−0.5	
No. 2	0.7	0	0	25	56.0	..	9.3	124[c]	133	+5.9	
No. 3	0.6	0	0	25	38.2	..	7.9	124[c]	132	+5.0	
No. 4	0.7	0	0	25	51.5	..	8.9	124[c]	127	+0.9	±3.4
No. 5	0.6	0	0	25	32.3	..	7.3	124[c]	122	−2.9	
No. 6	0.7	0	0	25	46.5	..	8.5	124[c]	121	−3.7	
No. 7	0.8	0	0	25	59.5	..	9.5	124[c]	119	−5.2	
Average value and probable error 125.6 ±1.4.											
Manufactured Gas Delivered to Pennsylvania State College on November 27 and 28, 1942											
No. 8	3.0	[d]	7	25	23.3	14.0	5.1	16.9[c]	17.0	−0.6	
No. 9	3.0	[d]	7	25	24.4	14.5	5.3	16.9[c]	16.9	−1.2	±0.9
No. 10	4.0	[d]	9	25	48.0	28.0	6.9	16.9[c]	17.3	+1.2	
No. 11	4.3	[d]	10	25	56.0	33.8	7.3	16.9[c]	17.2	+0.6	
Average value and probable error 17.1 ±0.06											
Manufactured Gas Delivered to Pennsylvania State College on December 18 and 22, 1942											
No. 12	5.0	4.8	12.0	15	51.6	29.5	8.3	..	10.0		
No. 13	5.0	4.8	12.0	15	49.2	28.0	8.2	..	9.8	±3.5	
No. 14	6.0	5.8	14.4	15	69.8	40.0	9.3	..	9.3		±2.0
No. 15	6.0	4.5	11.6	15	26.0	12.5	6.4	..	6.4	±2.5	
No. 16	7.0	6.0	15.0	15	39.0	18.0	7.1	..	6.1		

[a] Samples in brackets were taken from the line simultaneously or in immediate succession so as to give some idea of the over-all reproducibility.
[b] Diluent in milliliters is determined using the weight of condensate and a density of 0.67. Since the calibration curve for diluent is made on the basis of milliliters of diluent per 25 ml. of indicator solution, the volume of diluent is increased in proportion where only 15 ml. of indicator solution were added.
[c] Only one value of the weight of water by the drying tube method was determined in these series.
[d] These condensates were not weighed but estimated to contain about 1 g. of diluent per cu. ft. of gas sampled. The estimate was based on samples Nos. 12 to 16.

Test Results

The results of the colorimetric determination of water vapor in air and in manufactured gas are presented in Table I. The data on air were obtained by saturating compressed air in a thermostat at 20 C. The air was bubbled in series through two bottles of water containing glass beads and then through a bottle of glass wool to trap any water spray. The room temperature was kept warmer than the saturator bath to prevent condensation in the tubing. Previous data obtained in drying tubes indicated that the air is saturated in check experiments to plus or minus 1.0 per cent of the water content, and the observed deviation was due to variations in the temperature of the thermostat.

The samples of gas or air taken in pairs or in immediate succession are expected to have identical or nearly identical water contents and in Table I these samples are shown with brackets opposite the sample numbers. The manufactured gas delivered through a 9-mile line from the water-gas plant near Bellefonte, Pa., was sampled directly from the laboratory pet cocks. Samples taken on November 27 and 28, 1942, were expected to have nearly constant water contents because the maximum change in outdoor temperature was 16 F. Samples taken on December 18 to 22, 1942, might be expected to have lower and more varied water contents because the minimum outdoor temperature dropped 28 F. while the maximum fluctuation in temperature during these four days was 36 F.

In general, the colorimetric analysis of water vapor in both air and manufactured gas indicates slightly higher results than those shown by the drying tube. The drying tube might be expected to give high results on manufactured gas, since there is always the possibility that a good drying agent may absorb other substances in addition to the water. Samples Nos. 8 to 11 of the manufactured gas show the drying tube to give slightly low results. The drier used in this instance was a U-tube filled with magnesium perchlorate (Anhydrone). Although this is satisfactory for drying air and the results for drying manufactured gas seem to give reasonable agreement with the colorimetric analysis, the use of magnesium perchlorate is not recommended for drying fuel gases because of the possibility of serious explosions.[7]

In comparing the results in Table I for the over-all reproducibility of the colorimetric method and the agreement with drying tube analysis, the average deviation is about ±2 per cent of the water content present. An estimated variation of no more than ±1 per cent in actual water content is believed to exist in successive samples of the same gas. Nonuniformity in successive gas samples and inefficient mixing of condensate and indicator (in all but samples Nos. 12 to 16) may account for some of the discrepancies observed. Slight reaction of the nonaqueous condensate may also be responsible for part of the error, since a mixture of the condensate from manufactured gas and the indicator test solution showed a dirty brown precipitate after about 2 weeks. However, since the transmission is read immediately after mixing the indicator and condensate and no marked off-shade color has been observed in the freshly prepared solutions, it is assumed that the reaction with the indicator solution is negligible for nonaqueous condensates obtained from most gases. Colored condensates would require a special calibration, but in this study all condensates were essentially water-white. While the results of the analysis obtained on the laboratory samples were not so precise as the reproducibility of transmission measurements on synthetic mixtures of water and cobaltous bromide indicated, the experiments were considered satisfactory for field testing.

The results obtained on field tests for determination of water vapor in natural gas are summarized in Table II. These determinations were made on samples containing hydrocarbon condensables, Nos. 4 to 10, and some samples without hydrocarbon condensables, Nos. 1 to 3 and 11 to 15. Samples were taken in pairs and in succession so that those which are averaged were expected to show essentially one composition. The dew-point determination of water content was taken during the time in which the first sample of the condensate was collected. On two different gas samples on which the dew point was read, both cases indicated lower water contents by about 10 per cent than shown by the colorimeter tests. It is conceivable that the gas may have carried some entrained water in a fine spray and this is not detected in the dew-point determination.

In samples of gas where the nonaqueous condensate is exceedingly large, such as samples Nos. 4 to 10 shown in Table II, the volume of gas measured by the wet-test meter may be significantly in error (up to 5 per cent) due to the removal of a large portion of the gas as condensate in the freezing tube. There is no easy way to correct for this

TABLE II.—WATER CONTENT OF NATURAL GAS DETERMINED WITH EVELYN PHOTOELECTRIC COLORIMETER.

Samples taken at United Natural Gas Company, Oil City, Pennsylvania

Sample	Water, gal. per million cu. ft. of Gas at Atmospheric Pressure		Remarks
	Calculated from Dew Point	Determined by Colorimeter	
No. 1	...	8.75	Low pressure samples taken in the United Natural Gas Company Research Laboratory, Dec. 10, 1942. Negligible amount of hydrocarbon condensables. Probable error ±2 per cent of water present
No. 2	...	8.16	
No. 3	...	8.3	
		Avg. 8.24 ±0.17	
No. 4	13.1	15.3	Alum Rock 8-in. suction line from wells, Dec. 11, 1942. Gas bled off the top of main through a ¼-in. valve. Dew point 22.0–22.5 F. at 9.5 psi. gage pressure = 13.1 gal. per million cu. ft. Probable error ±1.5 per cent of water present in Alum Rock line
No. 5	...	13.8	
No. 6	...	15.0	
No. 7	...	13.0	
		Avg. 14.3 ±0.18	
No. 8[a]	...	14.0	Same as above on Dec. 12, 1942. Probable error ±2.8 per cent of water present
No. 9	...	15.8	
No. 10	...	16.0	
		Avg 15.3 ±0.43	
No. 11	5.16	5.8	Gas from gasoline plant on high pressure 8-in. line in gate house, 107 psi. gage pressure. Gas sampled through stinger. Dew point 37.5 F., barometric pressure 14.3 to 14.4 psi. = 5.16 gal. per million cu. ft. Negligible amount of hydrocarbon condensables. Probable error ±6.3 per cent of water present
No. 12	...	5.57	
No. 13	...	5.0	
No. 14	...	5.27	
No. 15	...	5.87	
		Avg. 5.52 ±0.35	

[a] Because Alum Rock line had about 1 ml. of hydrocarbon condensable per cubic foot of gas sampled (or about 25 times as much hydrocarbon condensables as water), the beads and springs were omitted from the moisture adsorption apparatus for sample No. 8 and the springs only were used for samples Nos. 9 and 10. In the Alum Rock line, for each 10 cu. ft. of gas sampled 10 ml. of naphtha (boiling at 50 F. or above) were unavoidably collected.

[7] M. J. Stross and G. B. Zimmerman, "Hazards in the Use of Magnesium Perchlorate as a Drying Agent," *Industrial and Engineering Chemistry*, News Edition, Vol. 17, January, 1939, p. 70.

error in measurement of gas volume. An attempted correction may be made by weighing the total amount of condensate collected in the freezing tube while it is still cold, figuring its approximate volume, and adding this to the volume determined by the wet-test meter. The final results of samples Nos. 4 to 10 in Table II have been adjusted, but those in Table I have not been corrected.

The over-all average reproducibility, as indicated partly by the readings on successive samples, is about ±3 per cent of the water content present. Some of this error is believed to be due to failure of complete mixing of water and indicator solutions, since this was always a difficult problem and only samples Nos. 9 and 10 of Table II and samples Nos. 12 to 16 of Table I were mixed according to the thorough method described in this paper. Unfortunately, most of the data were gathered before the method of the analysis was well standardized, and it was evident from the beginning that thorough mixing of the condensed water and indicator was difficult and not entirely satisfactory. During the early part of this study the indicator was added to the condensate and then the mixture was poured from the freezing tube to a bottle for shaking. After this, the solution was poured alternately into and from the freezing tube in an attempt to mix any trace of water that remained in the freezing tube, but this was always regarded as ineffective.

In the instance of natural gas, it is also possible that gas samples taken in succession may vary to some extent in water content. In general, the experimental data indicate that samples collected simultaneously (bracketed in Table I) show the closest checks. It would have been desirable to run continuous series of dew points or drying tube tests simultaneously with the colorimetric tests in order to determine whether the gas sampled always had a constant composition. The samples discussed were all taken at atmospheric pressure, and none were taken from mains above 107 psi. pressure. It would, therefore, be desirable to get correlations of the colorimetric method with dew points on gas samples obtained from higher pressure lines as well as to improve the over-all reproducibility of the method; but, unfortunately, continued work on the determination of moisture in fuel gas had to be abandoned due to more immediately urgent problems. It is hoped that the rather detailed descriptions given here will help in a better solution of this problem when the work may again be continued. However, according to the results published by Levin, Uhrig, and Roberts,[8] a chemical method indicating much better results than the colorimetric method appears now to be available. The method is somewhat more involved, but it should be tested by other laboratories.

[8] H. Levin, K. Uhrig, and F. M. Roberts, "Determination of Water in Hydrocarbon Gases," presented before the Petroleum Division of the American Chemical Society, Detroit, April 12–16, 1943. To be published in *Industrial and Engineering Chemistry*, Analytical Edition.

Investigation of the Air-Entraining Properties of Portland Cements Effected by the Addition of Vinsol Resin*

By W. J. McCoy[1]

RECENT investigations have indicated that the best performance of concrete in resistance to surface scaling and to freezing-and-thawing tests was obtained when the concrete contained about 3 to 5 per cent entrained air. It was also pointed out that air contents above 5 per cent produced no appreciable increase in resistance and caused reduction in strength as the air content increased.

Small amounts of Vinsol resin are frequently employed to entrain air in concrete mixes. The resin is usually added to the cement during the finish grinding of the cement clinker; however, air entrainment can be obtained by the addition of a solution or an emulsion of the resin at the time of mixing the concrete.

The present A.S.T.M. Emergency Alternate Specifications for Portland Cement (EA – C 150)[2] state that Vinsol resin may be added to type I and II cements in amounts not less than 0.025 and not more than 0.045 per cent by weight of the cement. It appears that the reason why the amount of Vinsol resin in air-entraining cements is specified is to insure adequate air entrainment in concrete to obtain the desired durability, but yet not excessive air seriously to affect the strength. In view of this limitation on Vinsol resin, the relation between amount of Vinsol resin added to a cement and the amount of air entrainment produced in concrete was investigated.

Ten air-entraining type cements which contained an amount of Vinsol resin within the A.S.T.M. specifications were selected from ten different mills and the air entrainment produced by each cement was determined by the A.S.T.M. Tentative Method of Test for Air Content of Freshly Mixed Concrete (C 173 – 42 T).[3] Since the air content of concrete is more or less affected by the mix, the aggregate, the consistency, the mixing equipment, and the time of mixing, these factors were standardized for all determinations of air content so as to eliminate these variables. The Vinsol resin content of the samples was determined by the A.S.T.M. Standard Methods of Chemical Analysis of Portland Cement (C 114 – 42).[4] Figure 1, in which the air content produced by these ten cements is plotted against their Vinsol resin content, shows no apparent correlation. It is interesting to note that the Vinsol resin contents of all the cements are within the range as specified by the A.S.T.M. emergency specifications EA – C 150, but all but two of them entrain air in excess of 3 to 5 per cent which investigations have indicated to be the most desired.

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* Manuscript received March 13, 1944.

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[2] 1942 Book of A.S.T.M. Standards, Part II, p. 1017.

[3] 1942 Book of A.S.T.M. Standards, Part II, p. 1203.

[4] *Ibid.*, p. 14.

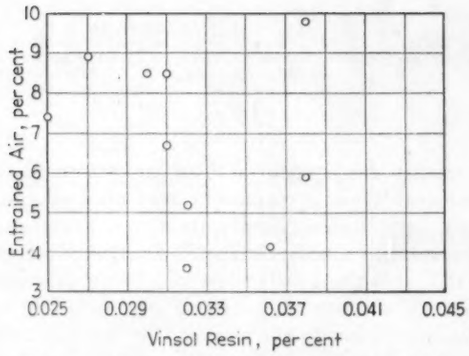

Fig. 1.— Cements from Ten Different Mills.

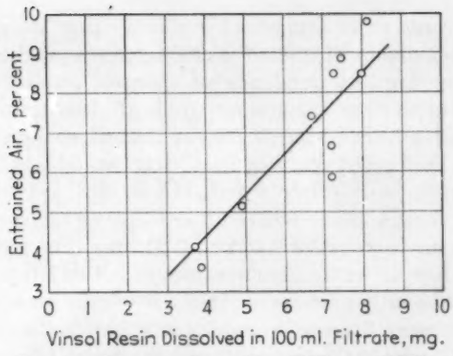

Fig 2.—Cements from Ten Different Mills.

When no correlation was found between the percentage of Vinsol resin and air content, a complete check of the chemical and physical properties of the ten samples was made. This included chemical analysis and calculated compound composition, free lime, total alkali, specific surface, and calculated particle-size distribution. A calculation was also made of the amount of Vinsol resin per unit of surface area. Special tests were made on the filtrates after mixing the samples with water for the same time and with the same approximate water-cement ratio (1:2) as used in the procedure for the determination of air content. These tests on the filtrates included the determination of pH, amount of dissolved CaO, the alkalinity and free alkali as outlined in the Merriman test for these values except the filtrates in this case were obtained after a much shorter leaching time. Since the Merriman test for free alkali includes alkali hydroxides and alkali salts whose anion forms an insoluble compound with barium, a modified free alkali determination was made to approximate the alkali present as the hydroxide. In this case the CaO dissolved in the filtrate was precipitated with CO_2 and the resulting $CaCO_3$ filtered off and the filtrate boiled free of CO_2 and titrated with standard acid. When this check on the chemical and physical properties was completed, a tabulation of the data was made by listing the samples in the order of their increasing air content and then inspecting the various columns of data for a correlation as would be indicated by a trend of either increasing or decreasing values. However, no trend was discernable, not even in the alkali data. In fact the cement which contained by far the least total and water-soluble alkali was in the middle of the list.

The next step in the investigation was undertaken after a theoretical consideration resulted in the conclusion that if some Vinsol resin were rendered soluble during the mixing of the concrete it would increase its effectiveness as an air-entraining agent. To investigate this point, water-cement mixes of the ten samples were made up with the same approximate water-cement ratio (1:2) and mixed for the same time as in the case of the air determinations. After mixing, the slurry was poured into a large Buchner funnel and sucked free of water. The amount of Vinsol resin dissolved in the filtrate was determined by adding 5 ml. HCl to a 100-ml. portion of the filtrate and extracting with chloroform by the same procedure as outlined in the A.S.T.M. method for determination of chloroform-soluble substances (C 114 – 42)[4] after dissolving the cement sample. A definite correlation can be observed upon inspection of Fig. 2 in which the air contents produced by these ten cements from ten different plants are plotted against the weight of Vinsol resin in milligrams extracted from 100-ml. portions of their filtrates.

The deviations in Fig. 2 could be expected since these ten samples represent both types I and II cement and are from ten different mills. To eliminate some of these variables, three samples of air-entraining cement of the same approximate fineness and composition were obtained during a short grind at one plant at which the rate of Vinsol addition was varied so the three samples contained different amounts of Vinsol resin. The amount of entrained air in concrete made from these samples, their total Vinsol resin content, and the Vinsol resin dissolved when mixed with water were determined for these three samples and the data are illustrated in Fig. 3.

These tests offer further evidence that the amount of air entrainment does not necessarily depend on the Vinsol resin content of the cement. Examination of Fig. 3 will reveal that the sample containing 0.036 per cent Vinsol resin resulted in an air content of 4.7 per cent, while the sample containing 0.040 per cent Vinsol resin had an air entrainment of only 3.4 per cent. Good correlation was obtained between the air content and the amount of dissolved Vinsol resin.

Three samples were obtained during three different grinds of air-entraining cement from each of two different plants. Total Vinsol resin, soluble Vinsol resin, and air content were determined on each of these six samples. In the cements from these two mills there was correlation between the total Vinsol resin and air content as well as between the soluble Vinsol resin and the air content. However, one important observation was noted from

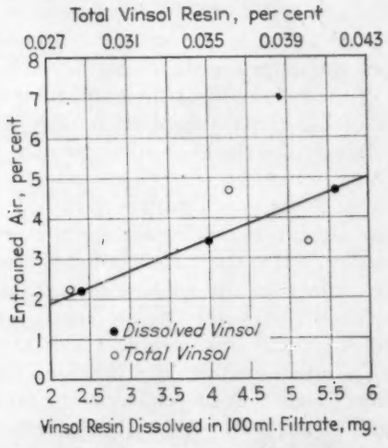

Fig. 3.—Data for Three Cements from the Same Mill.

these data and from data of other plants—that the amount of air entrainment of cement is characteristic of the plant.

After noting this tendency of cements produced at a given plant to have a characteristic high, low, or medium amount of air entrainment it was desired to investigate the clinker for any peculiarities that would cause this. Some Griffin mill product which contains gypsum was obtained from a plant where air-entraining cements with Vinsol resin contents of 0.025 to 0.035 per cent gave consistently low air-entrainment values of 2.4 to 3.6 per cent. This Griffin mill product in 15-lb. lots was ground to a normal cement fineness in laboratory ball mills with 0, 0.01, 0.02, and 0.03 per cent Vinsol resin. The water-soluble Vinsol resin values and air entrainment produced by these laboratory grinds were as follows:

Vinsol Resin, per cent	Vinsol per 100 ml. Filtrate, mg.	Air, per cent
0	...	1.8
0.01	6.5	6.8
0.02	11.1	10.3
0.03	15.7	13.2

These data are significant in that the same clinker and amount of Vinsol resin that resulted in small air entrainment in commercial grinds were capable of producing excessive air entrainment when the finish grinding was done in a laboratory mill. Also in the laboratory grind the air entrainment was approximately proportional to the Vinsol resin content which is not always the case in commercial grinds. It should be pointed out that the same approximate ratio between soluble Vinsol resin and air content was obtained for these laboratory grinds with high air entrainment as was obtained for the mill grind samples which gave very low air entrainment. To generalize on all the data mentioned so far, it would seem that the air entrainment of a cement does not depend on the amount of Vinsol resin present but on it availability which varies with the nature of the finish grinding of the cement. The Vinsol resin dissolved during the mixing operation appears to be an index of this availability.

Some additional tests were made to determine the solubility characteristics of Vinsol resin. Filtrates were obtained by treatment of two normal cements (not air-entraining) produced at different mills. One cement contained a high soluble alkali content and the other a low soluble alkali content. These filtrates were obtained by the same procedure as employed in the soluble Vinsol resin determination. Some saturated lime water was also prepared. The solubility of 0.15-g. portions of powdered Vinsol resin after a 10-min. suspension in 100 ml. of these three solutions was determined. No appreciable difference in solubility of the resin in these three solutions was found. The weights of dissolved Vinsol resin were 23, 21, and 21 mg., respectively, for the high alkali extract, low alkali extract, and lime water.

On the basis of these solubility tests one should be able to entrain air in concrete by adding powdered Vinsol resin at the mixer. Also the soluble alkali content should have but little effect on the amount of entrained air obtained. To check this point the air content was determined on the high and low soluble alkali samples (not air-entraining), mentioned in the previous tests, when powdered Vinsol resin was suspended in the mixing water equivalent to 0.01 and 0.03 per cent of the cement. These tests resulted in the following data:

Vinsol Resin Added at Mixer, per cent	Entrained Air	
	Low Soluble Alkali Content	High Soluble Alkali Content
0.01	3.3	4.8
0.03	7.8	8.5

These results are in line with what was predicted in that considerable air entrainment was obtained in both cases with little difference despite the considerable difference in soluble alkali content. Further evidence indicating that it is the availability of the Vinsol resin that determines the amount of entrained air is brought out by the following facts. In the case of the two plants where these two samples were obtained, commercial ground air-entraining cements with approximately 0.03 per cent Vinsol resin will consistently produce air entrainment of less than 4 per cent in mixes of the cement produced at one plant and greater than 7 per cent in mixes of the cement from the other. However, if untreated cements are obtained from these two plants and 0.03 per cent Vinsol resin added at the mixer there is less than 1 per cent difference in the resulting air content.

In the cases where Vinsol resin was dissolved in the filtrates and in lime water after filtering off the excess resin, the filtrate was a clear yellow color. When the acid was added a definite turbidity immediately appeared which would indicate that a soluble calcium soap had been formed and then when acidified it hydrolyzed to insoluble resin acid and calcium ions. In view of this it appeared advisable to check on the air-entraining properties of the calcium soap of Vinsol resin. To do this a sample of the same lot of Griffin mill product, as used in the laboratory grinds previously mentioned, was ground to the same fineness with 0.01 per cent of the calcium soap and with 0.01 per cent of the sodium soap of Vinsol resin. The following tabulation compares the air entrainment produced by these samples with that produced by the Vinsol resin itself:

	Entrained Air, per cent
0.01 per cent calcium soap of Vinsol resin	6.7
0.01 per cent sodium soap of Vinsol resin	6.3
0.01 per cent Vinsol resin	6.8

The sodium soap, when added at the mixer, is also an effective air-entraining agent. Percentages of 0.01, 0.02, and 0.03 resulted in air contents of 5.2, 12.4 and 15.4 per cent, respectively. The sample of cement used in this case was from a mill which produces air-entraining cement with Vinsol resin contents of 0.03 to 0.04 per cent that have characteristically low air-entraining properties. It is obvious that the amount of air produced by the 0.02 and 0.03 per cent of the sodium soap added at the mixer is excessive.

Summary

Evaluation of the data obtained in this investigation indicates that the percentage of Vinsol resin, the alkali content, and the character of the clinker in a portland cement have little relation to the air entrainment produced in a mix. The efficiency of Vinsol resin in causing air entrainment seems to depend on the availability of the resin. The Vinsol resin dissolved during the mixing operation appears to be an index of the availability. This availability varies from one cement plant to another and in some cases from one grind to another in the same plant.

EDITOR'S NOTE.—The following papers by Messrs. Morrison and Nodwell were presented before the Society's Committee E-7 on Radiographic Testing, at the Forty-sixth Annual Meeting, of the American Society for Testing Materials, Pittsburgh, Pa., June 28, 1943.

Exposure Graphs for Radium Radiography of Steel

By A. Morrison[1] and E. M. Nodwell[1]

MANY TYPES of film for radiography are now obtainable, and for some of these, particularly those brought out recently, the characteristics are not known. Data on speed, contrast, and latitude would enable radiographers to use the various types of film with a minimum of uncertainty and loss of time, and would enable them to use a wider variety of films in their work, selecting the film according to its special qualities and its suitability for the work which is to be done.

The relationships between gamma-ray exposure, thickness of steel, and film density for each of several types of film were investigated.

The general method used was to place a number of pieces of film spaced along radii at different distances from the radium capsule and to remove and develop them after a known period of time, thus obtaining a series of exposures of different intensities. With distances chosen to give densities ranging from about 0.5 to 3.0, series of exposures were made in this way for each type of film with no steel, and with $^1/_2$, 1, 2, 3, or 4 in. of steel in front of each piece of film. From the densities obtained, curves were plotted showing density against exposure.

A lead cup with $^1/_8$-in. thick walls was used to hold the radium capsule and to filter the radiation from it. This is about equivalent to the usual steel or aluminum holder. Lead screens were used in front of and behind the pieces of film.

Preliminary experiments with Kodak Blue Brand and no-screen (direct-exposure) films, and 1 in. of steel, indicated that the optimum front screen thickness for detection of 2 and 3 per cent penetrameters was 0.015 to 0.030 in., and that the back screen could be any thickness from 0.015 in. up. The front screen was chosen to be 0.015 in. and the back screen to be 0.040 in. to protect the film against back-scattered radiation.

Pieces of film 4 by 5 in. were placed with lead screens in envelopes made of light-tight paper. The 0.040-in. lead screen gave rigidity to the holder. With each set, one piece of film was left unexposed and was developed as a control in order to obtain the background density. All film of each type was taken from the same box.

All films were developed in Kodalk at 68 F. for 5 min. The developer was fresh to begin with, and it was felt that the total amount of film developed was not sufficient to change its characteristics appreciably. A very uniform procedure was used in order to minimize any differences arising in development. Previous work had shown that the usual vertical agitation would not contribute to even development, and this led to the adoption of a horizontal type of agitation. Each hanger in turn was grasped firmly, so that it remained vertical in the solution, and was moved slowly to the left-hand side of the tank. When all the hangers had been shifted horizontally to the left-hand side in this way, the one which was now on the right-hand side was grasped and moved slowly across to the extreme right-hand side of the tank. The others were then moved in succession to the right-hand side. The left-hand hanger was now moved horizontally to the left-hand side of the tank, followed by the others in turn. Then all were moved to the right-hand side again and, finally, to their original positions, that is, two complete cycles of horizontal shifting were made. This procedure was done twice during the 5-min. development period—at the end of the first minute, and at the end of the third minute.

All density measurements were made with an Eastman densitometer.

Exposures were calculated in terms of "Exposure Factor."

$$\text{Exposure factor} = \frac{\text{milligrams of radium} \times \text{minutes of exposure}}{(\text{source to film distance in inches})^2}$$

for example, for 250 mg. placed 20 in. from the film for 2 hr.

$$\text{Exposure factor} = \frac{250 \times 2 \times 60}{(20)^2} = \frac{30{,}000}{400} = 75$$

From the densities obtained on the exposed films, and from the exposure factors required to produce these densities, a series of curves, one curve for each thickness of steel, was plotted for each type of film. Fig. 1 shows this series for Type K film and for thickness of 0, 0.5, 1, 2, 3, and 4 in. of steel. Semilogarithmic paper was used

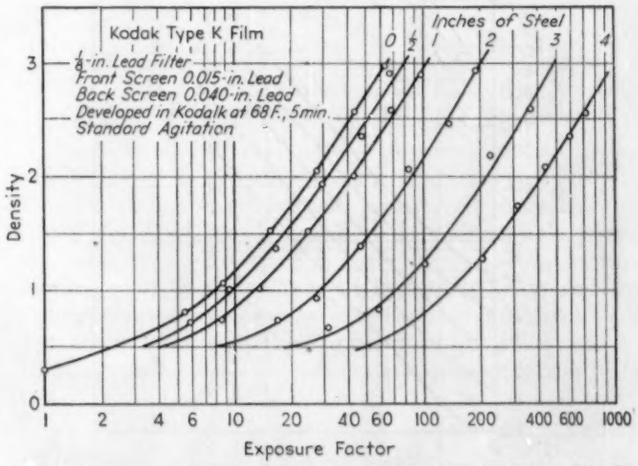

Fig. 1—Exposure Factor — Density Curves for Various Thickness of Steel for Kodak Type K Film

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so that the density could be plotted linearly as the ordinate and exposure factor as abcissa on a logarithmic scale. In effect, density was plotted against the logarithm of the exposure. Where possible, these curves were projected to density 3.0.

From these curves the exposure factor required to obtain any specified density can be found for each thickness of steel. The exposure factors required for type K film to get density 1.0 were as follows:

Thickness of Steel, in.	Exposure Factor
No steel	8.0
0.5	9.9
1.0	13
2.0	28.6
3.0	73
4.0	139

These were plotted on a graph with exposure factor as ordinate and thickness of steel as the abcissa, and an almost straight line was drawn through them (Fig. 4). This straight line was projected as a dotted line to a thickness of 6 in. Similar figures were obtained and plotted for densities of 1.5, 2.0, 2.5, and 3.0, and this series of five curves gives an exposure chart for type K film.

For each film a similar set of curves showing density against exposure factor for various thicknesses of steel was prepared, and from these curves the final exposure curves, Figs. 4 to 9, were obtained.

Figures 2 and 3 are a comparison of the density-exposure factor curves for the different Kodak films with no steel (Fig. 2) and with 2.0 in. of steel (Fig. 3).

In the preparation of these curves Kodak films were used. Of these, Blue Brand and type F were practically identical in their behavior. Supplementary experiments without steel showed that du Pont 504 and 502, and Agfa 670 corresponded quite closely to Kodak type F and Blue Brand, and that du Pont 506 and Agfa 674 corresponded to Kodak type A. The graphs for the Kodak films could,

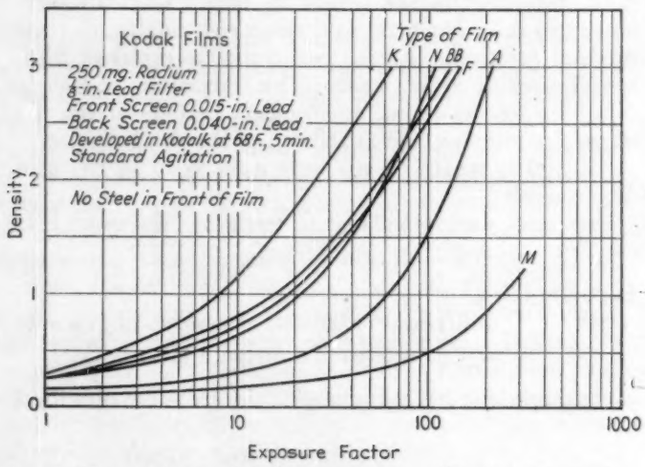

Fig. 2.—Comparison of Exposure Factor — Density Curves for Kodak Films (No Steel).

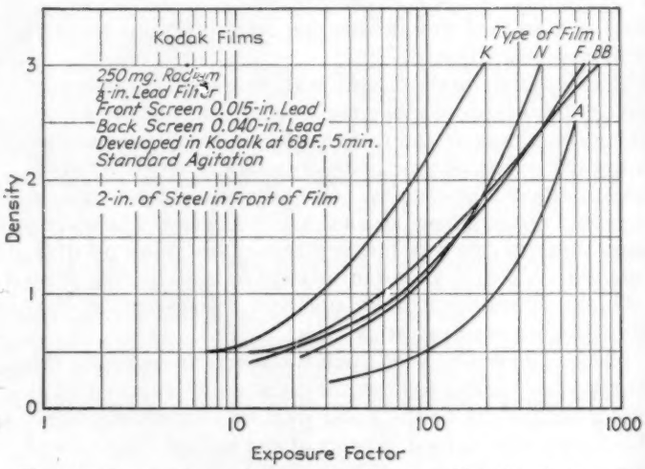

Fig. 3.—Comparison of Exposure Factor — Density Curves for Kodak Films (2.0 in. of Steel).

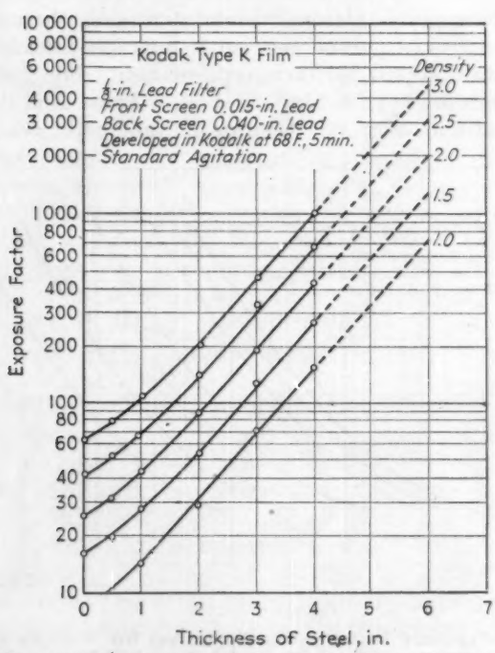

Fig. 4.—Exposure Graph for Kodak Type K Film.

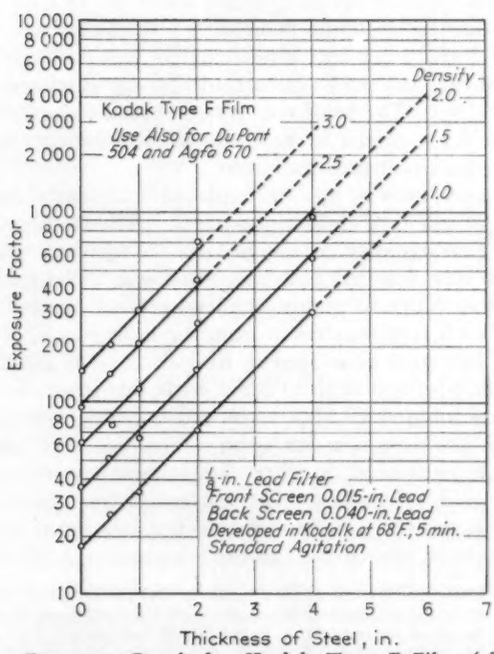

Fig. 5.—Exposure Graph for Kodak Type F Film (also for du Pont 504 and Agfa 670).

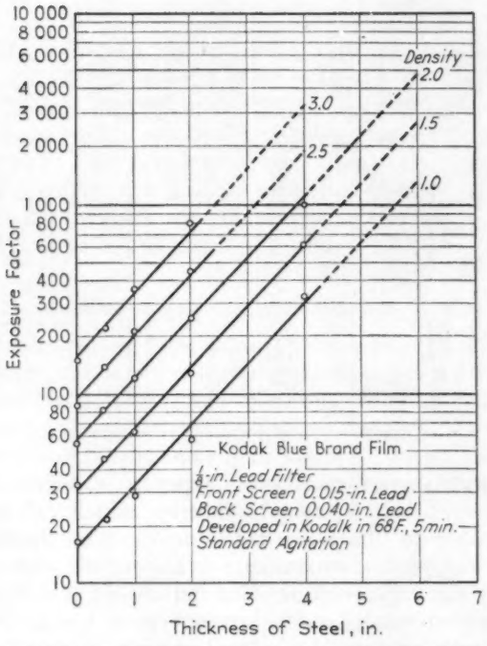

Fig. 6.—Exposure Graph for Kodak Blue Brand Film.

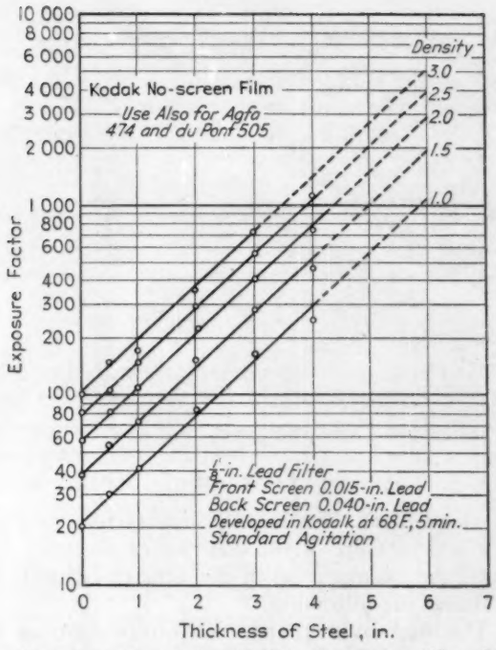

Fig. 7.—Exposure Graph for Kodak No-screen Film (also for Agfa 474 and du Pont 505).

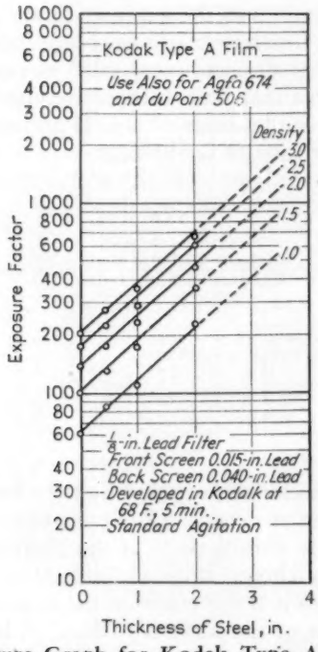

Fig. 8.—Exposure Graph for Kodak Type A Film (also for Agfa 674 and du Pont 506).

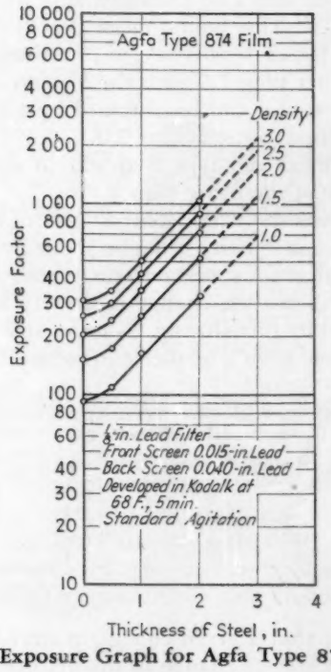

Fig. 9.—Exposure Graph for Agfa Type 874 Film.

therefore, be used for the corresponding Agfa and du Pont films. Agfa 874 did not correspond to any other film; a separate graph (Fig. 9) was drawn for it.

A series of exposures without steel was made for Kodak type M, and it was found to be very slow—so much so that it was felt that it would not be useful for radium work, and no further exposures were made with it.

Speed

A comparison of the speeds, as measured by the exposure factor required to produce a given density, shows that type K is the fastest at all densities and for all thicknesses of steel; that Blue Brand, type F, and no-screen have about the same speed, no-screen being slightly slower at low densities and slightly faster at higher densities and for greater thicknesses of steel; that Kodak type A and Agfa 874 are much slower, the 874 being slower than type A. Kodak type M is very slow, much slower than the Agfa 874.

An approximate comparison of the times required to get densities 1.0 and 2.5 without steel, and with 2.0 in. of steel is given in Table I.

TABLE I.

Type of Film	Density 1.0			Density 2.5		
	Exposure Factor	Relative Exposure Factor	Relative Speed	Exposure Factor	Relative Exposure Factor	Relative Speed
No Steel						
K	8	1.0	100	41	1.0	100
BB	16	2.0	50	86	2.1	48
F	18.5	2.3	43	96	2.3	43
No-screen	22	2.7	37	82	2.0	50
A	61	7.6	13.1	172	4.2	24
874	92	11.5	8.7	258	6.3	16
M	250	30	3.2	...	...	...
2.0 in. of Steel						
K	28.5	1.0	100	133	1.0	100
BB	59	2.1	48	450	3.4	30
F	74	2.6	39	420	3.2	32
No-screen	83	2.9	34	300	2.3	44
A	233	8.2	12	600	4.5	22
874	335	11.7	8.5	880	6.6	15
M	...	...	...	...	...	...

Contrast

The slope of the density-exposure factor curve at any density is a measure of the contrast of the films at that density. An examination of the density-exposure factor curve shows the following:

1. The films divide themselves into two groups, in one of which (types K, BB, and F) a constant slope is reached between densities 1.0 and 1.5, and in the other group (no-screen, type A, and 874) the slope appears to increase up to density 3.0. This would mean that there is little advantage, so far as sensitivity is concerned, in going to densities higher than 1.5 with the first group; but a considerable advantage can be obtained by using the second group at densities approaching 3.0.

2. Blue Brand and type F appear to suffer in this respect more than the other films.

Another measure of the contrast and of the sensitivity is the decrease in density brought about by an increase in thickness of steel for some constant exposure factor. The table below shows the change in density from an initial density of 3.0 by introducing $^1/_2$ in. of steel, a further $^1/_2$ in. of steel, and then a further 1 in. of steel.

DECREASE IN DENSITY WITH ADDITION OF STEEL
(Initial density 3.0.)

Type of Film	0 in. to $^1/_2$ in.	$^1/_2$ in. to 1.0 in.	1.0 in. to 2.0 in.
K	0.25	0.30	0.80
BB	0.42	0.40	0.70
F	0.37	0.45	0.87
No-screen	0.48	0.63	1.25
A	0.65	0.55	1.55
874	0.50	1.0	1.57

This shows that a given change in steel thickness produces a much greater change in the density in the case of no-screen, type A, and 874 than in the case of type K, type F, and Blue Brand or a given change in density in the film represents a smaller change in the thickness of material and hence a greater sensitivity in the case of no-screen, type A, and 874 than in the case of type K, type F, or Blue Brand. The type A and the 874 films are particularly outstanding, and this has important consequences in practice.

Latitude

The latitude of the film is an important characteristic since it determines, for any given thickness, the maximum and minimum exposures which will result in a usable radiograph, and for any given exposure it determines the maximum and minimum thicknesses which can be seen adequately in the same radiograph. Wide latitude is associated with low contrast, and again the films divide into two groups; type K, Blue Brand, and type F, which have wide latitude, and no-screen ,type A, and 874, which have much less latitude. One definition of latitude is the ratio of the exposure factors at any limits; for example, the latitude may be defined as the ratio of the exposure factor at density 3.0 to the exposure factor at density 1.0. Density 3.0 is chosen since it is the highest density that we were able to measure, and density 1.0 was chosen as being about the lower limit at which sensitivity of 2 per cent, or better, can be obtained. Table II gives a set of values using this definition of latitude.

TABLE II.

Type of Film	Latitude = Ratio of Exposure Factor at Density 3.0 / Exposure Factor at Density 1.0			Latitude Relative to K for 1.0 in. of Steel
	No Steel	1.0 In. of Steel	2.0 In. of Steel	
K	7.2	7.0	6.7	1.0
BB	10.0	10.1	10.4	1.4
F	9.0	8.5	8.8	1.2
No-screen	5.0	5.0	4.8	0.71
A	3.3	3.2	3.2	0.46
874	3.4	3.2	3.2	0.46

Another measure of latitude might be the ratio of the exposure factor at density 3.0 to the exposure factor at some arbitrarily chosen slope of the characteristic curve. The arbitrarily chosen slope in Table III is 30 deg., that is, the lower limit is the point on the characteristic curve where the slope of the curve is 30 deg. A line at 30 deg., if drawn through exposure factor 10, has an ordinate of 0.97[2] on the density axis at an exposure factor of 100.

TABLE III.

Type of Film	Latitude = Ratio of Exposure Factor at Density 3.0 / Exposure Factor where slope = 30 deg.			Latitude Relative to K for 1.0 in. of Steel
	No Steel	1.0 In. of Steel	2.0 In. of Steel	
K	12.4	15.0	12.0	1.00
BB	12	15.5	20.5	1.03
F	10.5	12.5	13.0	0.85
No-screen	8.2	6.8	8.2	0.45
A	6.4	6.8	7.0	0.45
874	6.9	6.0	6.2	0.40

[2] There is no particular significance to the number 0.97 since this derived quantity depends upon the scale of the graph paper.

These results show that there is a considerable difference in the latitude of the two groups of films previously mentioned. They also show that while a rough estimate of the exposure will result in a fairly satisfactory radiograph with type K, Blue Brand, and type F films, since they have a large latitude, much more accurate exposures are required with the high contrast small-latitude films such as no-screen, type A, and 874.

Use of the Exposure Graphs

If a piece of steel 2.0 in. thick is to be radiographed using type F film, the exposure factor required to get the density 1.0, from Fig. 5, is 74. An exposure factor of 620 will give the density 3.0. The actual exposure must, therefore, lie between these limits, and any exposure between these limits will give a picture which can be read if a fairly bright light source is available. With type K film (Fig. 4) the exposure factor required would be from 33 to 210, while with Agfa 874 (Fig. 9) an exposure factor of 330 to 1050 could be used. This illustrates the wide range of exposures which can be selected by choosing the proper film. It also illustrates the latitude which can be allowed in gaging exposure times.

The exposure factor includes three variables—time, distance, and amount of radium. The amount of radium available is usually fixed, and the time for exposure may be fixed, or the minimum time may be required. The dimensions of the object and its shape will usually fix the minimum distance which can be used. Once the time or the distance is decided upon, the other can be calculated from the exposure factor, for example, for the case above, if the exposure factor is 74 and there is a 200-mg. capsule of radium available which can be used at a minimum distance of 10 in., the time required will be calculated from the equation

$$\text{Exposure factor} = \frac{\text{mg. of radium} \times \text{minutes of exposure}}{(\text{source to film distance})^2}$$

$$74 = \frac{200 \times t}{100}$$

therefore, $t = 37$ min.

If an overnight exposure were desired, for which the time might be 16 hr. or 960 min., the calculation would be

$$74 = \frac{200 \times 960}{(\text{S.F.D.})^2}$$

therefore, S.F.D. $= \sqrt{2600 \text{ in.}} = 51$ in.

From Figs. 4 to 9 it can be seen that for a given exposure factor, the range of thicknesses for which the density range is from 1.0 to 3.0, is about as follows:

Type of Film	Thickness, in.
K	2.4
BB	3.1
F	3.0
No-screen	2.4
A	1.9
874	1.6

In some cases a two-film technique can be used to increase the range of thicknesses examined. Two films of different speeds are placed in the cassette or exposure holder with the usual front and back lead screens, and with a lead foil of 0.010 or 0.015 in. thickness between them. The faster film will record the thick sections and the slower film the thinner sections. For example, at exposure factor 400, Kodak type K will cover a range from 5.3 to 2.8 in., and a Kodak type A in the same cassette with lead foil between the films would cover the range from 3.0 to 1.0 in. Thus the total range examined would be from 1.0 to 5.3 in., and with an exposure factor of 300, no-screen and 874 would jointly cover the range from 0 to 4.0 in.

It should also be noted that density 3.0 is not the upper limit of viewing. Using a very intense source such as a photoflood lamp, densities from 4 to 5 can be used. These higher densities are particularly advantageous with a film such as no-screen, A, or 874, where the contrast is maintained, and even increased, as the density increases.

In addition to the speed and range, it is also necessary to consider the sensitivity required. The finer the grain and the higher the contrast, the better will be the sensitivity which can be attained. The grain size decreases in the same order as speed, type K having the coarsest grain. If small defects are expected or thin sections are being examined, it may be advisable to sacrifice speed and use type A or 874.

For the sake of uniformity, all films were given the same time of development, namely, 5 min. at 68 F. in Kodalk. This time of development can be increased to 8 or 10 min. for the no-screen types of films, such as Kodak types K, A, no-screen, du Pont 505 and 506, and Agfa 474, 674, and 874; and the exposure times can then be decreased somewhat. For the screen type films, there is no gain in developing for more than 5 min. in Kodalk at 68 F.

Radium Radiography of Thin Steel Sections

By A. Morrison[1] and E. M. Nodwell[1]

The use of radium for the radiography of steel and bronze has been limited to sections of 1 in. or more in thickness. This has been due, in part, to unsatisfactory sensitivity at thicknesses of less than 1 in. with the screen type film usually recommended for radium radiography. Another factor was the higher contrast and greater speed of X-rays, when available. With the new high-contrast, fine-grain films, it was felt that it might be worth while to ascertain the penetrameter sensi-

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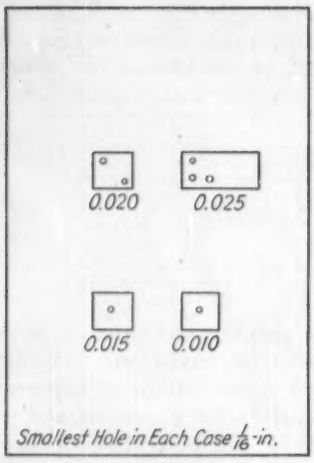

Fig. 1.—Arrangement of Penetrameters on Steel Block.

tivity for 1/2-in. steel, since cases occurred where X-ray inspection was not available, and where gamma-ray radiography might be used if the desired sensitivity could be obtained.

The general experimental arrangements for this series of exposures were the same as those described in the paper on Exposure Graphs for Radium Radiography of Steel,[2] 1/2-in. thick pieces of steel being placed at different distances, arranged radially around the radium capsule. Four penetrameters, 2, 3, 4, and 5 per cent of the 1/2-in. thickness, were placed on each piece as in Fig. 1.

The lead screens and the developing technique were the same as previously described. After the films had been exposed and developed they were examined with an ordinary light and with a bright light to find the least thickness of penetrameter which was visible.

The following films were used: Kodak types M, A, no-screen, and F, du Pont 506, and Agfa 674 and 874. The best results were achieved with type M, 874, 506, type A, and 674.

In general, it was found that for each type of film, and for each penetrameter, there was a minimum density below which the penetrameter could not be seen. The thinner the penetrameter the higher was the minimum density required. The *approximate* minimum densities for each penetrameter and for each film are given in the table below:

Penetrameters, per cent	Type F	No-screen	Type A	674	506	874	Type M
2.....	...	2.8	1.6	1.6	1.6	1.3	1.4
3.....	...	1.6	1.4	1.1	1.1	1.3	1.4
4.....	1.1	1.1	1.0	0.8	0.8	0.9	0.9
5.....	1.1	1.1	1.0	0.8	0.8	0.9	0.7

Conclusions

1. A certain minimum density must be reached.

Type of Film	Penetrameters	
	2 per cent	3 per cent
M, 874.....	1.3 to 1.4	1.1 to 1.2
506, A, 674.....	1.6	1.1 to 1.4
No-screen.....	2.8	1.6
F.....	Not obtainable	Not obtainable

To insure the visibility of 2 per cent penetrameters the minimum density should be about 1.5 to 1.6, and the visibility is better as the density increases. No-screen is evidently not as good a film for this purpose as the others since a much greater density is required.

2. For this type of work, exposure graphs such as those shown in the paper on Exposure Graphs for Radium Radiography of Steel[2] are required since the most suitable films for this purpose have small latitude and therefore the exposures must be accurately estimated in order to get the desired density. From the exposure data it will be seen that for 1/2-in. of steel an exposure factor of 130 to 150 is required for type A, 506, 674, and 874 film and an exposure factor of 400 to 450 is required for type M film. Thus type M would not appear to be practicable for this type of work.

3. The film-handling and developing technique should be of high quality so that no stains or finger marks will obscure the defects.

4. A small source size is a distinct advantage since the edges of the defects will be sharper and can be more readily seen. Because the section is thin and the defects are therefore close to the film, this small source size, although advantageous, is not as necessary as might be thought at first. It is important, however, to choose the source to film distance to be appropriate to the source size.

5. In this, as in any other radiography, good viewing conditions can make the difference between seeing the defects which the radiograph records, and missing them. A bright light source should be available since high density is essential in this work. The film should be so shielded that there is no adjacent area brighter than the film itself. Any adjacent bright area will hinder the eye in accommodating itself to the brightness of the film. The room should be somewhat darkened as the fine-grain films have rather glossy surfaces and any extraneous light in the room will reflect from the film and decrease the visibility of the shadows.

While freely admitting that X-rays would be preferable in the radiography of thin sections of steel there are some circumstances under which radium radiography may be necessary; for example, there may be no X-ray machine available or the position of the area to be examined may be such that X-rays cannot be used, or the particular work which is to be done may not warrant the purchase of an X-ray machine nor the transportation of the work to an X-ray machine.

Small foundries often cannot use X-ray radiography in control and development, because, with a limited volume of production, they cannot afford the high voltage X-ray equipment which would be required to penetrate the thicknesses often encountered in their work. Radium radiography is particularly suitable here, since, by choosing the proper film and technique, all thicknesses from 1/2 in. to 3 or 4 in. or more can be handled.

Radium radiography has been successfully used on the welds in pressure vessels of wall thickness 1/2 to 1 in. where it was not possible to take them to an X-ray machine, or to bring an X-ray unit to them.

[1] See p. 25.

Use of Film to Measure Exposure to Gamma Rays

By A. Morrison[1] and E. M. Nodwell[1]

ONE OF THE questions always present when radium or radon is used in medical or industrial radiology is the extent to which personnel are being exposed to radiation. As an aid in establishing and maintaining safe working conditions, a method of measuring the exposure received at any point, or by any person, over a period of time is needed. X-ray film can be used for this purpose provided that the limitations and the necessary precautions are understood. S. D. Herbein has published results[2] of a test using Eastman Blue Brand film, correlating density with accepted dosage tolerance.

The essential basis of this method is the establishment of a relationship between the amount of radiation received by a film and the blackening of the film thus produced. This relationship can then be used to determine the amount of radiation received by persons carrying film, and if the amount of radiation in a tolerance dose is agreed upon, the safety, or otherwise, of working conditions will be known.

To determine the relationship between film density and the amount of radiation received, pieces of film are given a series of known exposures, resulting densities are measured, and from these a blackening curve is plotted. The amount of radiation received by a film varies directly as the amount of radium used and as the length of exposure, and varies inversely as the square of the distance from the film to the radium, and is thus proportional to $\frac{\text{radium} \times \text{time.}}{(\text{S.F.D.})^2}$ For this quantity, where the amount of radium is in milligrams, the time is in minutes, and the source to film distance (S.F.D.) is in inches, the term "Exposure Factor," is used:

$$\text{Exposure factor} = \frac{\text{milligrams of radium} \times \text{exposure time in minutes}}{(\text{S.F.D. in inches})^2}$$

The blackening curve is therefore plotted as density *versus* exposure factor and can be used for any combination of radium, distance, and time. From this curve any degree of film blackening can be interpreted in terms of exposure factor.

The unit of dosage measurement generally used, and in which tolerance dosages are expressed, is the roentgen unit (*r* unit). It is necessary to have a conversion factor between *r* units and exposure factor.

It seems to be generally agreed that the amount of radiation received in 1 hr. at 1 cm. (0.39 in.) from 1 mg. source of radium, with 0.5 mm. platinum filter, is about 8 roentgen units. The corresponding exposure factor is $\frac{1 \times 60}{(0.39)^2} = 394$. Therefore, 8 *r* units = exposure factor of 394 and 1 *r* unit = exposure factor of 49.3.

There is a wide variation in published standards for tolerance dosage. That recommended by geneticists is 0.025 roentgen per day. A tolerance of 0.2 roentgen per day is quoted by Kaye, Bell, and Binks.[3] The National Bureau of Standards Handbook, H.23, states tolerance dosage as 0.1 roentgen per 7-hr. day and as this is generally accepted we have used it here. An exposure of 0.1 roentgen per 7-hr. day = exposure factor of 4.93 per 7-hr. day or 29.6 per 6-day week. The blackening corresponding to this exposure factor can be obtained from the characteristic curve for any film.

Characteristic curves may be obtained for as many films as desired. The exposures for these curves may be made by arranging a number of films in light-tight envelopes at equal distances from the radium and removing them at varying intervals, or by arranging the films at various distances and removing all at the end of the appropriate time. Lead plates 0.040 in. or more in thickness may be placed behind the envelopes to protect the film against back scatter from the walls of the room and from other objects in the room.

For high accuracy conditions of exposure and development for test films should be the same as those used in obtaining the blackening curves. For high accuracy the films used for tests should be from the same lot, and preferably from the same box, as those used for preparing the blackening curves, as there are unavoidable variations in the manufacture of film.

An unexposed piece of the film used for preparation of each blackening curve should be developed as a control film to check on the fog density level produced with that film, developer, and development technique, and a similar control taken from the same sheet as the test films should be developed with the test films. If lead screens are used in preparing the blackening curves then similar screens should be used with the test films, and the surface of these lead screens should be clean in both cases.

Variation in development of the film must be guarded against. It is essential that the temperature of the developer and of the fixer be kept constant and that the time of development, rinsing, fixing, washing, and drying be held constant for all films which are to be compared. Either no agitation, or better, a standard method of horizontal agitation should be used. The degree of exhaustion of the developer must be about the same for test pieces as for those used in preparing the characteristic curve.

For preparing the characteristic blackening curve, density measurement should be obtained from an instrument which measures diffuse densities such as an Eastman, Ansco-Sweet, or Marshall densitometer.

When such an instrument is not available it will be necessary to use someone else's blackening curve and to duplicate their conditions of exposure and development as far as possible and to estimate the density by comparisons with pieces of film of known density.

Some consideration should be given to the suitability of the film to be carried. Fine-grain films blacken slowly. The density is not as easily estimated by comparison when

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[1] Division of Physics and Electrical Engineering, National Research Council of Canada, Ottawa, Canada.

[2] S. D. Herbein, "Industrial Radiography." Vol. I, No. 1, p. 39 (1942).

[3] G. W. Kaye, G. E. Bell, and W. B. Binks, "Protection of Radium Workers from Gamma Radiation," *British Journal of Radiology* Vol. VIII, P. 6 (1935).

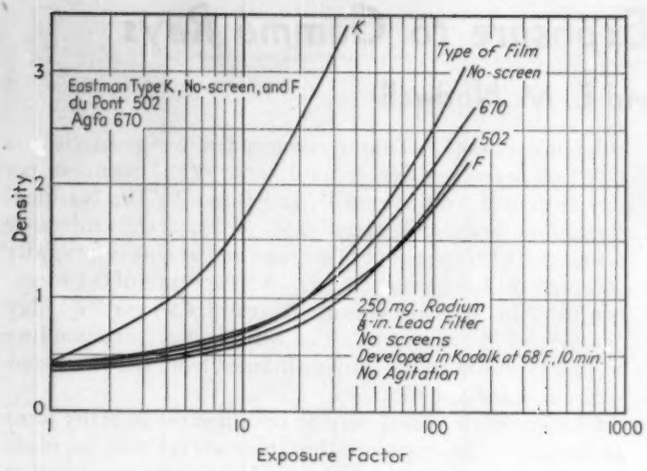

Fig. 1

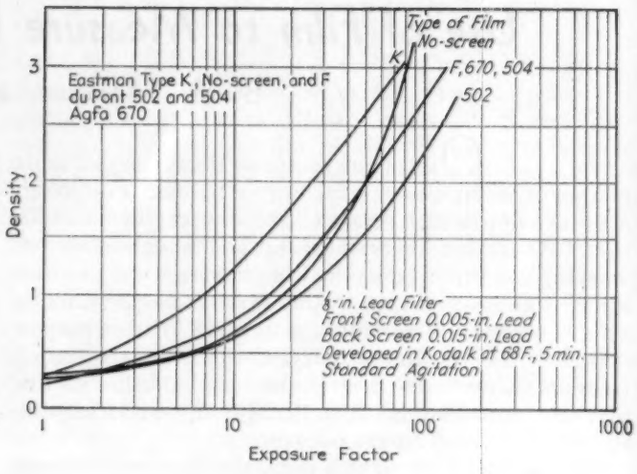

Fig. 2

an instrument is not available, and slight differences in background density constitute too great an error. The medium grain, medium speed films are suitable. Figures 1 and 2 show curves for Eastman type K, no-screen, Agfa 670, du Pont 502, and Eastman type F. Eastman Blue Brand and du Pont 504 have similar curves to type F. Curves for Eastman type K are included because of its popularity in the gamma-ray field. It would be a suitable film for testing 1 day's exposure because of its speed. Curves are shown in Fig. 1 for exposure without lead screens and in Fig. 2 for exposure with a 0.005-in. front screen and a 0.015-in. back screen.

Referring to Fig. 1, it will be seen that, accepting the previously stated values for tolerance dosage, and roentgen unit, the density corresponding to the exposure factor 4.93 is 0.58 and to 29.6 is 1.17 with a particular lot of Agfa 670 film (no exposure, density = 0.40). That is, this film carried for a day, should have shown not more than 0.58 density and should have shown not more than 1.17 for a 6-day week. Similarly, the densities for any film can be found.

Lecture on Foundry Metallurgy

THE BULLETIN cannot hope to note all outstanding contributions in the field of materials, but from time to time there are some items which merit notation, even though brief . . . or tardy. Therefore, we note the lecture by J. W. Bolton on "Foundry Metallurgy in the Castings Industry" the first A. F. A. Foundation Lecture, presented in 1943 and published in September *Transactions* of the American Foundrymens' Assn. For those who are concerned with this field and for all who enjoy a well-prepared discussion, it is recommended reading. While the first lecture was to be a general review of progress, specifically metallurgical progress in the castings industry, there are no generalities in the paper. It is a very direct and thought-provoking discussion covering many of the important relevant problems. In the section on gray iron, the author, referring to Specifications—Selection and Prescription, says "it is unfortunate that many have not given specifications (a 'measuring stick' of the engineering worth of a product) the consideration they deserve. Too often specifications are viewed as afflictions. A positive and constructive attitude, personal interest, and personal support are needed. If specifications are considered inadequate, there certainly is a welcome awaiting those willing to help in making them better and more useful. If testing methods have shortcomings, or better methods are desired, any technical committee will greet with open arms all who are willing to work. It is not argued that specifications are a substitute for the integrity and skill of the manufacturer. They are supplementary, and of greatest value as an objective measuring stick, subject to independent tests or other check."

In the discussion on steel castings he cites certain A.S.T.M. standards and referring to malleable iron he lists the steps to promote manufacture and sale according to definite physical specifications. "Guarantees of minimum tensility and ductility are reassuring to the engineer and designer. Much also was done to standardize manufacturing procedures. For years, one trade group has promoted its product as 'Certified Malleable.' The industry as a whole follows specifications such as those of the A.S.T.M."

There are numerous references to A.S.T.M. in the discussion on nonferrous foundry problems. The section on principles in technology and discussion on foundry metallurgy, castings industry, and the machine age are pertinent reading whether one is concerned with the foundry industry or not.

In his closing remarks referring to the A. F. A. he states

"The Association is an educational and technical society for the whole castings industry. Men from different and often competing foundries have found that it is of great value to trade ideas and help each other. Perhaps it is not equally clear to the branches of the industry that they too have much in common, and that much remains to be done in the matter of concerted attack on the educational and technical problems shared by all.

"Review of technical advance teaches clearly that rate of progress is accelerative. The Association well may have just pride in its accomplishments. Yet all should remember that even more swift progress is needed to meet the challenges of the future. And what is the Association? It is a group of individuals. Since it is composed of individuals, the Association advances in proportion to the degree that individuals support it actively, personally and financially. Conversely the Association will retrogress if individuals regard it as a mutual admiration society, pay for nominal membership, and let direct interest lag."

Data Compiled on Aluminum Alloys

A VERY helpful compilation has again been compiled by the Federated Metals Division of American Smelting and Refining Co. giving in condensed form lists of the various grades and classes of aluminum sand castings, permanent mold castings, die castings, and ingot materials as covered in various specifications. The latest compilation includes data on wrought alloys as well. Details are given on chemistry, physical properties, and related information. For comparative purposes the booklet on aluminum should be very helpful and those who are concerned with this field can obtain a copy of the publication by writing to the Office of General Manager, General Aluminum Dept., Federated Metals Div., American Smelting and Refining Co., Russell at Woodland, Detroit, Mich.

Outstanding Symposium on Plastics; Philadelphia Sessions Draw Big Crowds; Excellent Papers

If any additional evidence were needed of the intense interest of the materials engineer in the subject of plastics (and there is no such need!), the Symposium on Plastics held in two sessions in Philadelphia on February 22 and 23 would more than suffice. There were 450 present at the Franklin Institute on the Parkway on Tuesday, February 22, and the second session held in the Benjamin Franklin Hotel Ballroom on February 23 was attended by over 650.

From the technical standpoint, the sessions were notable for considerable new information and data presented; and the sessions were climaxed by a summary of outstanding features of the various plastic families as prepared by leading authorities and summarized by Dr. Gordon M. Kline, National Bureau of Standards.

Preceding each session informal dinners were sponsored by the Philadelphia District Committee which arranged for the symposium in cooperation with Committees D-9 on Electrical Insulating Materials and D-20 on Plastics. About 125 attended each dinner at the hotel where the authors, technical chairmen, and Society officers were guests of the Philadelphia District.

The program for the symposium was as follows:

Technical Chairman: Robert Burns

1. Introduction to Symposium—Robert Burns
2. Heat Resistance of Laminated Plastics[1]—E. O. Hausmann, and A. E. Parkinson, Continental-Diamond Fibre Co., Newark, Del.; and G. H. Mains, National Vulcanized Fibre Co., Wilmington, Del.
3. Effect of Environmental Conditions on the Mechanical Properties of Plastics—T. S. Carswell and H. K. Nason, Monsanto Chemical Co., Springfield, Mass.
4. Diffusion of Water Through Plastics—George Deeg, Jr., and Carl J. Frosch, Bell Telephone Labs., Inc., Murray Hill, N. J.
5. Testing of Nonrigid Plastics—R. F. Clash, Jr., and R. M. Berg, Bakelite Corp., Bound Brook, N. J.

Technical Chairman: Myron Park Davis

6. The Behavior of Plastics under Repeated Stress—B. J. Lazan, and A. Yorgiadis, Sonntag Scientific Corp., Greenwich, Conn.
7. Testing in Connection with the Development of Strong Plastics for Aircraft—Henry Sang, Aeronautical Engineer, Naval Air Experimental Station, Philadelphia, Pa.
8. Summary of Properties, Uses and Salient Features of Families of Plastics—G. M. Kline, National Bureau of Standards, Washington, D. C.

   Preparing this section of the symposium are the following:

   I. Phenolic Materials—Molded and Laminated—W. A. Evans, Bell Telephone Laboratories, Inc., New York, N. Y.
   II. Urea and Melamine Plastics—Ladislav Boor and Marshall Howard, American Cyanamid Co., Stamford, Conn.
   III. Allyls—Franklin Strain, Columbia Chemical Div., Pittsburgh Plate Glass Co., Barberton, Ohio
   IV. Vinyl Plastics—Rigid and Nonrigid—H. L. Drukker, Carbide and Carbon Chemicals Corp., New York, N. Y.
   V. Acrylates—Willard F. Bartoe, Röhm & Haas Co., Bristol, Pa.
   VI. Polystyrenes—W. C. Goggin, Dow Chemical Co., Midland, Mich.
   VII. Cellulose Plastics—W. E. Gloor, Hercules Powder Co., Parlin, N. J.

[1] This paper represents the work of Section III on Thermal Properties of Subcommittee III of Committee D-9 on Electrical Insulating Materials.

Publication of Plastics Symposium

Manuscripts of the technical papers comprising the Symposium on Plastics are being reviewed and edited for publication in a special volume. The scope of this undertaking naturally entails considerable time in handling numerous details, but it is hoped the book will be available for distribution in the late spring. Members will receive further announcements.

There was a combination of circumstances which contributed to the outstanding success of this symposium. First, the series of technical committee meetings of D-9 and D-20 were in progress in Philadelphia from Monday, February 21, through February 24, thus bringing to the meeting a large number of the country's leading plastics technical authorities, several of whom participated in the symposium. Also the promotional efforts of the Philadelphia District, including the extending of a number of invitations to several local technical groups, was responsible for the attendance of many outside of A.S.T.M. to the sessions. But the success fundamentally rested on the very excellent cooperation given by the authors of the technical papers.

Francis G. Tatnall, Baldwin-Southwark Division, The Baldwin Locomotive Works, chairman of the Philadelphia District, headed the program committee, with Messrs. G. H. Mains, National Vulcanized Fibre Co., and R. W. Orr, RCA Victor Division of Radio Corporation of America, district secretary, serving. E. J. Albert, Thwing-Albert Instrument Co., arranged for the successful dinners, and the transportation and reception committee headed by A. O. Schaefer, The Midvale Co., with L. E. Ekholm, Alan Wood Steel Co., W. J. Jeffries, Philadelphia Ordnance District, and E. K. Spring, Henry Disston and Sons, Inc., functioned efficiently, especially in getting the dinner crowd from the hotel to the Institute promptly via a special trolley car. Judson F. Vogdes, Jr., Pennsylvania Economy League, handled promotion for the meeting.

Materials Supply List

Issue No. 11 of the Material Substitutions and Supply List dated January 15 records a number of changes in supply which are now rather general knowledge among materials engineers; for example, the easing of copper and steel from Group I (insufficient for war plus essential industrial demands) to Group II which is characterized by having sufficient supply to meet war demands plus essential industrial demands under existing controls. Most chemicals and plastics have become slightly tighter, and there was practically no change in lumber, textiles and fibers classifications, many classes of lumber and textiles being in Group I. An exception to the general easing in non-ferrous materials was tin because of its continued critical supply. The use of tin in bronzes and plating should be avoided wherever possible. Another such exception was the advance of lead from Group III to Group II, due to a gradually declining supply.

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PHILADELPHIA, PENNA.

1945 Book of Standards Advanced One Year

ANNOUNCEMENT is made of the decision by the Executive Committee to issue the next Book of Standards *not* in 1945 as would be the normal procedure of triennial publication but this year, 1944. This decision to advance appearance of the book by a full year is caused by the unusually heavy demand for the 1942 edition. Although in planning for the current book, due allowances had been made for increased sales and membership, the supply is such as to carry us through 1944 only. Rather than attempt to go back on press with the whole book which would entail considerable typesetting because in the meanwhile a number of standards have been changed with reprints issued and the 1943 Supplements, it was thought in the interest of everyone to plan for the 1944 book which would be ready early in 1945. On this basis there will be no 1944 Supplements.

There will be a number of mechanical details to be resolved, for example the standing committees already are bringing their specifications and tests as up to date as possible for inclusion in the 1944 book, printing schedules are involved and anyone having any contacts with printers knows how jammed up presses are, and there is the question of advance purchases for the 1944 Supplement. All of these matters are being studied and further announcement will be made.

Meanwhile all three of the 1943 Supplement parts have been mailed to members in accordance with the parts of the 1942 book they have. All purchasers of the book who have not provided for purchase of the Supplements should plan to do so, so that their books may be complete.

Technical Information

WITH DISTRIBUTION of the 1943 *Proceedings* imminent,[1] and pending publication of the Symposiums on Applications of Synthetic Rubbers, and on Plastics, there is opportunity to comment on one important service which the Society and many other cooperative technical organizations can render, namely, the compilation and correlation of authoritative data on materials, processes, and products. No group can cover the field entirely, but it is of tremendous service to the engineer and technical man, who in this day and age has to cover such a wide gamut of problems, to have available publications which provide material gathered from a large number of authoritative sources. For example, the new publication issued by the National Bureau of Standards entitled "Mechanical Properties of Metals and Alloys" owes its value and almost very existence to the extensive publications issued by various societies providing data which are summarized and coordinated in this valuable book. The Symposium on Applications of Synthetic Rubbers, the papers in which are very briefly summarized in this BULLETIN, will provide the producer and user of synthetic rubbers with extremely pertinent facts, and the Plastic Symposium likewise.

There is another source of information and perhaps a most valuable one and yet few think of the Book of A.S.T.M. Standards as a reference volume. "Why, it has specifications and tests!" Yet every specification must have relevant data on the quality of a product. Whether the pertinent properties are tensile strength and elongation, or viscosity and flash point, or spreading power and opacity, or what have you, the fact remains that these standards include properties and authoritative data which can be relied on by the materials engineer.

The opportunity of receiving technical information and data is one of the primary advantages of membership in the Society, and the availability of A.S.T.M. publications for reference is of vital importance to the whole technical and engineering field.

[1] After considerable delay because of printing production and binding problems.

Nominations for Officers

THE NOMINATING Committee to select nominees for Society officers met in Cincinnati on March 1. The personnel of this group was listed in the December, 1943, ASTM BULLETIN. In accordance with the provisions of the By-Laws of the Society the following nominations are announced:

For President:

P. H. BATES, Chief, Clay and Silicate Products Division, National Bureau of Standards, Washington, D. C.

For Vice-President:

ARTHUR W. CARPENTER, Manager of Testing Laboratories, The B. F. Goodrich Co., Akron, Ohio.

For Members of Executive Committee:

W. C. HANNA, Chief Chemist, California Portland Cement Co., Colton, Calif.

L. B. JONES, Engineer of Tests, Test Department, The Pennsylvania Railroad Co., Altoona, Pa.

J. T. MACKENZIE, Chief Metallurgist, American Cast Iron Pipe Co., Birmingham, Ala.

J. G. MORROW, Metallurgical Engineer, The Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada

SAM TOUR, President, Sam Tour and Co., Inc., New York, N. Y.

Each of the above nominees has indicated in writing his acceptance of his nomination. The By-laws provide that "further nominations, signed by at least 25 members, may be submitted to the Secretary-Treasurer in writing by May 25, and a nomination so made, if accepted by the member nominated, shall be placed on the official ballot" which "shall be issued to members between May 25 and June 1."

What About the Status of A.S.T.M. Standards?

Are They Private, Governmental, American or World? Who Makes Them? Who Uses Them?

In a commercial organization, the production men are concerned with one basic problem, getting out the goods, and the sales organization must see that the product is sold. But the production manager and sales manager have much in common, frequently tying in their contacts through an executive setup. Regardless of the internal mechanics, there is the common problem of getting out the product and seeing that it is used.

There is also the problem of market research. What other lines are needed to supplement the existing products.

Since 1902, the organization of which this Bulletin is the news medium has concentrated its "production" facilities, if we may use that term, on, first, development and publication of specifications and tests, termed "standards," and, second, promoting better knowledge of materials, through compiling authoritative data on their properties.

There have been problems of production, to be sure. Nevertheless, most have been surmounted and the more than 1200 standard and emergency specifications bearing the symbol "A.S.T.M.," offer convincing evidence that here indeed is a considerable output.

What about the sales? Are they recognized and used? A few instances will, it is hoped, justify the conclusion we are leading to. Of course the war emergency has stimulated much keener and widespread appreciation of the value of standards of all kinds, dimensional standards involving simplification; quality standards for materials and products; performance standards; and a host of others. Discounting the effect of the war, there is no question that A.S.T.M. materials standards have been, and are, to an increasing extent, more widely applied than even the best informed member would think possible.

1. In Codes: The material requirements in many of the country's leading codes are based on A.S.T.M. The A.S.M.E. Boiler Code and pressure vessel codes incorporate A.S.T.M. standards, in practically all cases *in toto*. The Boiler Code now uses A.S.T.M. designations as identification. Most of the country's leading building codes incorporate a great many A.S.T.M. specifications and test methods. Unified codes base materials requirements on our standards. The code recommended by the National Board of Fire Underwriters in an appendix lists more than 70 pertinent A.S.T.M. standards.

2. A review of the printed standards will indicate that many carry in the right-hand corner of page one a reference, for example, "Approved by the American Foundrymens Association" or "by the Society of Automotive Engineers" or "American Petroleum Institute," and others; indicating that this particular document has been officially adopted by the organization noted.

3. Numerous societies, trade associations, and technical groups point with pride to the contacts they maintain with the committees of the Society. They have had a part in helping to draft, formalize, and keep up to date the A.S.T.M. specifications and tests.

4. A list of the municipal, state, and Federal departments and branches (notably in the latter case, Bureau of Standards, Navy, Army, Engineers, Quartermaster, etc.) is—to say the least—indicative of the desire of these forces represented on A.S.T.M. committees to be in touch with A.S.T.M. work. We know that the armed services are making widespread use either by reference, by using basic requirements perhaps slightly modified, or in similar ways of A.S.T.M. specifications. Publications purchased by the Federal Government are a good indication of the value inherent in our standards.

5. Private Industry: While no formal file or records could possibly be maintained on the use of our standards in the commercial field, one has only to attend a technical committee meeting or ask the representative of an organization, to get evidence that the standards are covering the quality of a great many products, and in the case of many organizations a considerable percentage of their production. An interesting evidence of the use of standards is the annual purchase by industry of thousands of copies in separate pamphlet form.

6. International: That the work of A.S.T.M. technical committees in developing specifications and tests is of world-wide significance is attested by the extensive peacetime use of these standards covering export orders. Voluminous communications and correspondence received at Headquarters, personal comments from the members, such approval, for example, as given by the British Institute of Petroleum Technologists, recent statements by American representatives in Latin American countries, all point to the stature of the Society as a recognized body whose "products" are accepted with confidence. The standards have had a most important part in exchange of goods with foreign countries during this war effort.

7. American Standards Association: A recent review of the list of standards which have been approved by the American Standards Association indicates that of the 600 items, 240 are A.S.T.M. standards. In the ramifications of recognition by this organization established as a federation to coordinate standardization activities and minimize overlapping of work, it is significant that all of these were accepted with scarcely any suggestions for change.

Who Makes Them?

As was the case in 1902, so is the situation now that the standards are evolved and consummated by the country's leading materials engineers. The constitution of A.S.T.M. technical committees indicates that their personnel includes men whose judgment as representatives of consumers and producers can be open to little question. If they do not know the answers, the answers are probably not known (but in most cases, they find the answer). These members are carefully selected by the different industries and technical groups who have occasion to use the standards. The specifications and tests as published are widely applicable because they are the result of a broad point of view over

the entire field of engineering materials and are designed to serve as wide a variety of interests as possible without sacrificing the necessary detail for specific purposes.

The membership of the Society is a representative cross-section of the American engineering profession in all its branches. Its position, therefore, is supported not only by its own widespread membership, but also by its close relationship with technical societies and commercial associations through common membership.

Every effort is made to see that the interests concerned shall have a voice in A.S.T.M. specifications. When published, the proposed new standards are on trial for a year or more before formal adoption in which time they are circulated to interested bodies for comment and criticism.

There can be no question on the competency of an A.S.T.M. specification. It is based on best commercial practice with the properties not the highest that can be produced but those that can be reasonably and consistently produced. Each standard embodies adequate scientific research and the sound engineering judgment of men who are living with the materials.

What About It:

Why have we recorded the above? First, we think it well occasionally to record an inventory of this kind in the BULLETIN so that members may devote some thought to the subject. Each member has the obligation and duty in the support of the Society to do what he can to promote the use of our specifications and tests. The more widely used they are, the more efficient it is believed will be the use of the material and the more benefit will be derived from the work of several thousand technical people serving on committees. Also we wish to point out the necessity of any standardization work being on a firm foundation such as that insured by A.S.T.M. procedure. Too, we are cognizant of the considerable interest in international standards. Also we wish to emphasize that A.S.T.M. Standards are national in scope and are truly American standard in every sense of the term. We believe that the Society, by which we mean its membership, can take pride in realizing that the A.S.T.M. standards are authoritative, unbiased, are being extremely widely applied, and are national and international in scope.

Society Membership Continues at Peak

LATEST DATA on number of members in the Society indicate that as of March 1, there were 5129 members, of which 4547 were in the United States and its possessions, and 155 in Canada, 115 in England, and the balance, 312, in various other foreign countries. Adding to this total figure of 5129 the number of individuals serving on technical committees other than Society members (usually as additional representatives of company membership), there is a grand total of 6723 members and committee members.

Some comparative data are of interest. For example in 1931 the membership was 4380, and on February 1, 1941, the figure was almost the same, 4357. There has been in the three years (from Feb. 1, 1941, to March 1, 1943) a precentage increase of 17.7 (increase in U. S. and possessions 17.6, with Canada showing 33.6 increase in the past three years). The number of non-member committee people has increased some 25 per cent, reaching a total of almost 1600.

Because of the pressure of technical and editorial work at A.S.T.M. Headquarters, there is not much opportunity to compile statistics and data that would undoubtedly be of interest, but recently a breakdown of number of members plus committee members that had been compiled on February 1, 1941, was brought up to date as of March 1 this year. These figures show the record of each state with percentage increases in three years, the latter figures being mostly significant where there are a reasonable number of members in a state. With the figures available it was easy to arrange the tabulation showing state ranking which appears here. Concerning net gains, New York State, with the largest number of members, barely held its own with 0.6 per cent increase, whereas Pennsylvania showed an increase of 10.3 per cent. Among the other leading states and District of Columbia, percentage increases ranged from 15.9 for Michigan up to 42.3 per cent for Indiana.

TABULATION SHOWING STATE RANKING AS OF MARCH 1, 1944.

Number of Members		Committee Members (Not A.S.T.M. members)		Totals, Members and Committee Members	
1. New York	(681)	New York	(292)	New York	(973)
2. Penna.	(666)	Penna.	(228)	Penna.	(894)
3. Illinois	(414)	Ohio	(186)	Ohio	(554)
4. Ohio	(368)	New Jersey	(175)	Illinois	(520)
5. New Jersey	(306)	D. of C.	(120)	New Jersey	(481)
6. Michigan	(244)	Illinois	(106)	Michigan	(325)
7. Calif.	(233)	Michigan	(81)	D. of C.	(269)
8. Mass.	(187)	Mass.	(79)	Mass.	(266)
9. D. of C.	(149)	Conn.	(52)	Calif.	(258)
10. Conn.	(132)	Del.	(42)	Conn.	(184)
11. Indiana	(101)	Maryland	(36)	Maryland	(135)
12. Maryland	(99)	Indiana	(24)	Indiana	(125)

SUSTAINING MEMBERSHIP

Marked Increase in Sustaining Members

The January BULLETIN listed on page 39 ten additional leading companies who became Sustaining Members of the Society during January, 1944.

During the past few weeks a number of additional organizations have become Sustaining Members, subscribing to this class which entails dues of $100 as a means of rendering support to A.S.T.M. to a degree more commensurate with the advantages to the organizations of our technical activities. In most cases there has been a transfer to the Sustaining class from their present company membership. A list of these organizations follows:

Celanese Corp. of America, Plastics Div.
Cessna Aircraft Co.
Fulton Sylphon Co.
Humble Oil and Refining Co.
Industrial Synthetics Corp.
Kennecott Wire and Cable Co.
National Vulcanized Fibre Co.
Precision Castings Co.
Sheffield Steel Corp.

1944 A.S.T.M. Annual Meeting

The Waldorf-Astoria, New York City, June 26–30

Information of room reservations will be sent members late in April.

Important New Standards Actions, Including Emergency Matters

Standards Committee Acts on Zinc-Coated Wire, Copper Bus Bars and Pipe, Petroleum Tests, Plastics Methods, and Thermometers

SINCE PUBLICATION of the January BULLETIN, Committee E-10 on Standards, which has the authority to act for the Society in connection with certain recommendations from standing committees, has approved several new test methods and has taken favorable action on proposed Emergency Alternate Provisions, certain of which are published in the back portion of this BULLETIN. The accompanying box lists the various items with latest serial designations.

Provisions on Zinc-Coated Wire:

These Emergency Alternate Provisions involving specifications for Zinc-Coated Iron or Steel Barbed Wire (A 121) and Zinc-Coated Iron or Steel Farm-Field and Railroad Right-of-Way Wire Fencing (A 116) were developed in order that the requirements could be coordinated with WPB Order L 211, Schedule 3, which includes certain size and coating limitations. These provisions are in the interest of expediting procurement and conservation of steel and zinc. See page 56 for details.

Copper Bus Bars and Pipes:

These two new specifications covering Copper Bus Bars, Rods, and Shapes (B 187) and Copper Bus Pipes and Tubes (B 188) were developed by Committee B-5 on Copper and Copper Alloys which has issued a large number of specifications and methods of testing. These particular materials are for electrical conductors. It is required that orders specify the kind of copper, dimensions and form, length, temper, weight, special tests and special packaging when required. Recommendations on all of these purchase items are given in the specifications. Although the physical properties for the bars include tensile strength, elongation, and bend, as well as specified electrical properties and hardness requirements, the first three requirements are effective only when specifically stated in the order. Tensile strength ranges from 32,000 to 40,000 psi., depending upon the shape and size of the material; strengths of tubing and pipe are in the same range. In each of the new standards there is a statement concerning embrittlement. It is indicated in each that material designated as oxygen-free or deoxidized will pass the specific embrittlement test. The actual performance of this test is not mandatory *unless specified*.

Free-Cutting Brass Rod:

This Emergency Alternate Provision would permit higher contents of certain elements which have been built up during the war period in scrap, including tin, iron and nickel. These elements, besides copper, zinc and lead, the principal constituents of this free-cutting brass rod, have definite limits in this new emergency provision (EA – B 16). War conditions have resulted in higher quantities of certain impurities in the scrap which has to be utilized for the production of this rod. The changes in the opinion of those concerned will not entail any material sacrifice in the quality of the product and will definitely aid in the war effort. By this provision the present chemistry could be waived, the iron now 0.15 max. would read 0.35 max.; the present requirement of 0.50 per cent max. for other materials than copper, lead, iron and zinc would be modified to provide for a top of 0.30 max. tin; 0.50 max. nickel, with the other minor elements having a maximum of 0.50 per cent. This provision was approved on March 21 on the recommendation of Committee B-5 on Copper and Copper Alloys.

Protective Properties of Organic Coatings:

The Emergency Methods for Determining Protective Properties of Organic Coatings on Steel Surfaces When Subjected to Immersion (ES – 35) were issued to give promptly methods needed in determining resistance to failure of organic coatings when immersed in certain specified liquids. Requirements are given on the test procedure—that is, the type of panel to be used, preparation of specimens, application of coating, and, finally, examination of the panels.

Determination of Inorganic Elements in Lubricants:

Subcommittee XI on Determination of Inorganic Ele-

Recent Actions by Committee E-10 on Standards

NEW AND REVISED TENTATIVE STANDARDS

Specifications for:

Copper Bus Bars, Rods and Shapes (B 187 – 44 T) (new).
Copper Bus Pipes and Tubes (B 188 – 44 T) (new).
Enclosures for Small Testing Machines for Tests at Subnormal and Supernormal Temperatures of Electrical Insulating Materials and Plastics (D 760 – 44 T) (new).
Servicing Units for Tests at Subnormal and Supernormal Temperatures of Electrical Insulating Materials and Plastics (D 761 – 44 T) (new).
A.S.T.M. Thermometers (E 1 – 44 T).

Emergency Methods of Test for:

Chlorine in Lubricating Oils by Bomb Method (ES – 36).
Chemical Analysis of Phosphorus in Lubricating Oils (ES – 37).
Chemical Analysis of Lead, Copper and Iron in Lubricating Oils (ES – 38).
Chemical Analysis for Metals in Lubricating Oil (ES – 39).

EMERGENCY ALTERNATE PROVISIONS

Standard Specifications for:

EA – A 116 Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad Right-of-Way Wire Fencing (A 116 – 39).
EA – A 121 Zinc-Coated (Galvanized) Iron or Steel Barbed Wire (A 121 – 39).

Method of Test for:

EA – D 129 Sulfur in Petroleum Oils by Bomb Method (D 129 – 39).

Note:

Members may obtain a copy on request without charge of the complete tentative standards and emergency standards noted above and also can procure the Emergency Alternate Provisions (pink slips). It was not found possible to include any of the above items in the Supplements to the Book of Standards. The Emergency Alternate Provisions listed, plus any others which may become effective meanwhile, will be mailed to each member later in the year.

ments in Lubricants, functioning under Committee D-2 on Petroleum Products and Lubricants, has considered and discussed at some length emergency methods for determining certain elements in petroleum oils and lubricating oils. There has been a demand from the armed forces and other sources for these methods and for this reason it was decided to issue the proposals as Emergency Methods, except that the emergency procedure for determining sulfur by the bomb method which is to be applicable for used and unused motor oils containing additives is to be an emergency alternate provision. Other emergency methods cover determination of chlorine (ES – 36) (it is indicated that satisfactory results had been obtained with oils containing as little as 0.1 per cent); phosphorus in both new and used oils containing from 0.001 to 1.0 per cent of this material (ES – 37). It is not applicable to materials containing organic derivatives of phosphine. Lead, iron, copper, calcium, barium, sulfur, and chlorine, often present as impurities or additives in lubricating oils, do not interfere. This method is also applicable, but with somewhat less accuracy, to the determination of phosphorus content of lubricating oil additives. In this case, the phosphorus content must be lowered by dissolving the additive in phosphorus-free oil, so that the percentage of phosphorus in the resulting mixture is in the range of 0.001 to 0.1.

The emergency methods for chemical analysis for lead, copper, and iron in lubricating oils, both new and used, (ES – 38) are applicable, even though other metallic elements, sulfur, chlorine, and phosphorus are present in amounts commonly found in lubricating oils.

As would be expected, the methods (ES – 39) covering emergency procedures for chemical analysis for metals in lubricating oil are quite extensive. The procedures are intended for the determination of barium, tin, silica, zinc, aluminum, calcium, magnesium, sodium, and potassium in new or used lubricating oils.

The analytical procedures follow the well-known scheme of separating the metals into groups for more convenient determination, as shown in a comprehensive diagram. This scheme provides a rapid and accurate method for the determination of all, several, or any one of the metals as may be seen necessary from an initial qualitative inspection of the oil sample.

Requirements on Machines and Servicing Units for Use at Non-Normal Temperatures:

The desirability of more detailed requirements on certain equipment used in conducting tests at sub- and supernormal temperatures of electrical insulating materials and plastics has been recognized and the need is met in part at least through two new tentative specifications, one covering enclosures for Testing Machines (D 760) and the other for Servicing Units for Maintaining Atmosphere (D 761). To an increasing extent A.S.T.M. committees are compelled to recognize the unusual effect which temperature and humidity conditions have on test results. In Committee D-9 on Electrical Insulating Materials there has been considerable work on environmental conditions for a test specimen. As a result of much study and discussion in both Committees D-9 and D-20 on Plastics, requirements are now set up for chambers suitable for total enclosure of small testing machines, such as are required in A.S.T.M. methods of testing electrical insulating materials and plastics. They are designed for use when tests are to be made below or above normal temperatures, specifically within the range from −70 to +170. The enclosures are to be in box form and of double-walled or equivalent construction with a dead air space or suitable insulation between the walls. The servicing units which are required to maintain atmospheres in enclosures to which they are attached must be housed in suitable double-walled insulated box. The standard further sets up a performance requirement on the blower system, heating capacity, refrigeration and temperature control.

Short Thermometer for Lacquers and Paints:

The Society through the work of its Technical Committee on Laboratory Apparatus, which functions as Subcommittee XII of Committee E-1 on Methods of Testing, has issued two widely used specifications for A.S.T.M. thermometers, E 1 – 42 and E 1 – 44 T. It is a practice of the committee to recommend that requirements for new thermometers as needed be issued in tentative form, and then, when use indicates the requirements substantially correct, to advance them from the tentative to formal standard status. These specifications cover a wide range of thermometers, many of which are used in the testing of petroleum, asphalts, paints, and related products. The latest additions to E 1 – 44 T are six new thermometers which meet the need for short range items for use in distillation tests of solvents and diluents used in manufacturing lacquers and paints. These have designations ranging from 37 C. through 42 C.—each specific thermometer carries a number which is a positive and quick identification.

Being added to the tentative specifications is an explanatory note on the periodic checking of changes of bulb volume of glass thermometers and also notes on the determination of ice-point.

Index to Standards

A 218-PAGE PUBLICATION entitled "Index to A.S.T.M. Standards, Including Tentative Standards," as of December, 1943, has been distributed to the members and copies are being forwarded to all purchasers of the 1942 Book of Standards and 1943 Supplements. Thus every individual or organization whether a member of A.S.T.M. or not who has a set of the books should get an INDEX for use with the publications.

This Index is designed to expedite reference to a particular specification in the publication where it appears; also it provides a ready means for determining whether the Society has issued any specifications or tests on a specific subject or material. Carefully indexed under key words are the some 1200 standards and tentative standards.

A helpful portion of the INDEX is a complete list in numeric sequence of the standards and tentative standards (with publication references) (including emergency standards) and there is also a list of Emergency Alternate Provisions.

This book is very widely distributed and copies are sent without charge to those who would find the publication of service.

Northern California Members Meet

FEATURING addresses by President Dean Harvey and Secretary-Treasurer C. L. Warwick a meeting was sponsored by the A.S.T.M. Northern California District in the Engineers Club in San Francisco on March 15. About 125 were in attendance, including a number of visitors and guests. Arrangements for the meeting had been made by Theo. P. Dresser, Jr., Secretary of the Committee and Chief Engineer of Abbot A. Hanks, Inc. Dozier Finley, Chairman of the District Committee and Director of Technical Research, The Paraffine Cos., presided. This meeting was one of two held on the West Coast during the visit of the two Society officers. The meeting took the form of an assembly and dinner following which the talks were given.

On invitation President Harvey spoke on "The Place of the National Engineering Society in Industry," outlining early engineering work, noting some of the earliest established American societies, and stressing some of their important contributions. Improving the professional standing of the members, encouraging development of engineers, and the sponsoring of technical work were among these. He named a few of the specific achievements of such societies as the A.S.C.E., A.S.M.E., A.I.E.E., S.A.E., A.S.M., etc., following which he described in detail how A.S.T.M. correlates its work with many of the other engineering and technical organizations. He said, "Of all the national engineering societies, the A.S.T.M. is the only one which has as its primary purpose the development of methods of test and specifications for materials. Other societies are doing work along these lines, but it is not their principal function. The A.S.T.M., therefore, is the one to whom the public looks for leadership in the field of materials. We, therefore, serve all of the other engineering societies along these lines."

Stressing the importance to each engineer of keeping up to date on products, President Harvey cited the correlation of information and its dissemination as an important accomplishment of the engineering groups.

On methods of testing, he referred to the important work of the testing machine and apparatus manufacturers constantly improving their products, citing, for example, the important time saving in autographic recording of results in tension testing. He discussed the contribution of materials to the war program, stressing in particular some of the conservation efforts. Concluding with a look into the future, Mr. Harvey again stressed the dependence of the engineer in industry upon the National Engineering Society.

The Secretary-Treasurer in his talk detailed some of the A.S.T.M. work, referring to meetings, activities, certain of the newer materials fields, and after these comments which were aimed to give those present an over-all picture of the "health of the Society" he cited numerous A.S.T.M. contributions in the war effort. Then he referred to the new A.S.T.M. Study Committee, stressing that although A.S.T.M. was extremely active, and was proud of its activities, it was not adopting a complacent attitude but rather one of continuing to improve its organization and operations to serve the members, industry, and government.

Los Angeles Meeting

AT THE MEETING sponsored by the A.S.T.M. Southern California District Committee, March 20, at The Biltmore Hotel, three topics were covered in the technical session which followed the informal dinner: textiles, WPB specifications work, and grain size standards for magnesium alloys. This meeting was arranged in conjunction with the Pacific Coast trip of President Dean Harvey and Secretary-Treasurer Warwick. Roy E. Paine, Aluminum Company of America, Secretary of the District Committee, consummated arrangements for the meeting, with Chairman W. C. Hanna, California Portland Cement Co., presiding at the meeting. About 200 were present at the technical session.

Following a suggestion from the district members, President Dean Harvey gave a short talk on textiles, reviewing natural and commercial fibers, including some of the advantages and disadvantages of each. He mentioned particularly some of the newer fibers, outlining developments leading to their production. Much of the accelerated development work in the industry has come about because of the increasing influences of the technically trained people, who are concerned not only with product development, but adequate methods of evaluating properties and control of quality. Pioneering work in this field was started, he said, by A.S.T.M. Committee D-13 on Textile Materials, and now its extensive compilations of standards are recognized widely.

Before covering important phases of WPB specifications work, Secretary-Treasurer Warwick outlined briefly some interesting developments in the work of the Society; then he discussed the role of specifications, relationship of WPB Conservation Division work with the Federal Specifications group, War and Navy Departments, etc., covering at some length the National Emergency Steel Specification project, and outlined the current conditions which are changing rapidly. Regardless of the changes in materials availability, conservation problems, and other pressing war and peacetime matters, the specifications, he said, will still be with us. He said in closing:

"Despite all our shortcomings—and no one is more aware of them than we who have been working in this field—we *have* accomplished much in standardizing materials specification requirements, in simplifying sizes and varieties of products, in bringing producers and consumers (including the biggest consumer of them all—Uncle Sam) to a realization of the value of the principles of standardization as applied to materials specifications. This has been accomplished under the pressure of a terrible war, to place ourselves on as simple and economic a basis as possible to fight that war. Why not retain all of it that is good? Much of what we have accomplished is as sound in Peace as in War. Then—why go back to *dozens of specifications* for a given material when one or a few will suffice? We trust that all agencies that have been engaged in this work will continue it after the war. A.S.T.M. assuredly stands ready to further this end in every way possible."

Grain Size Standards for Magnesium Alloys:

A technical paper on "Grain Size Standards for Magnesium Alloys" by C. H. Mahoney and A. L. Tarr, Metallurgical Dept., Basic Magnesium, Incorporated, outlined the interest in grain structure and pointed to the peculiar properties of magnesium alloys with respect to grain size. The finer grain size structure it possesses gives superior

mechanical properties, improves the effectiveness of solution treatment, and enhances machinability. Since grain size has such an important bearing on the magnesium alloys, the value of a recognized standard for recording and also correlating size to mechanical properties seems evident.

The authors then discussed the theory and application of A.S.T.M. Methods of Preparation of Micrographs of Metals and Alloys (E 2) and the chart of standards for estimating diameter of the average grain, particularly of nonferrous metals. Also they referred in detail to the Tentative Classification of Austenitic Grain Size in Steels (E 19) which includes the commonly termed "grain size chart." The proposed method for determining and recording magnesium grain size is based on the A.S.T.M. standards covering austenite grain size. Their system starts with the largest grains and proceeds higher numerically with decreasing size which would result in numbers for the most probable range in commercial application of from 7 to 16. These designations were obtained by relabeling the present austenitic network in A.S.T.M. (E 19) nine sizes greater. Finally, they discussed in detail preparation of the magnesium alloy specimens for determining grain size, outlining helpful procedures they had developed, recommended etching reagents, and precautions in polishing.

Philadelphia Meeting to Feature "Engineering Abroad"

UNDER the auspices of the Philadelphia District Committee, there is being held on April 20 at the Franklin Institute on the Parkway a meeting that should be of interest to all engineers, on the subject "Engineering Abroad." Waldo G. Bowman, Editor of the widely read publication *Engineering News-Record*, and the Managing Editor, Edward J. Cleary, will be the feature speakers. Mr. Cleary has spent considerable time recently in South America, particularly Brazil, and Mr. Bowman completed an extensive trip with visits to the European and Near East theatres involving England, North Africa, Iran, etc. Mr. Bowman will cover a number of interesting military installations and construction work in the theatre of war, and Mr. Cleary will describe and illustrate engineering work in South America of interest to all technical men including Ford's Amazon Basin Project, recently covered by him in an interesting article in the March 9 *Engineering News-Record*.

A graduate of the University of Kansas and Harvard Graduate School of Business, Mr. Bowman, following work in the materials field, has since 1925 been associated with *Engineering News-Record*, several years ago succeeding F. E. Schmitt as Editor. Mr. Cleary has been associated with the magazine since 1935. A graduate of Rutgers University in 1929, he devoted several years to field engineering work before his association with *Engineering News-Record*.

All A.S.T.M. members and those concerned with materials and construction are cordially invited to attend this meeting which will start promptly at 8 p.m.

Dr. Allan Bates to Speak at Cleveland District Meeting

THE CLEVELAND District Committee, A. J. Tuscany, Chairman, and R. T. Bayless, Secretary, has arranged a meeting at which Dr. A. Allan Bates, Manager of Chemical and Metallurgical Research, Westinghouse Electric and Manufacturing Co., Pittsburgh, will speak on "What of Engineering Materials in the Future?" The meeting is to be held in the Cleveland Engineering Society Auditorium, 2136 East 19th St., on Friday, April 14 at 8 p.m. Dr. Bates is well known to A.S.T.M. members and always delivers an interesting address. He will also cover some of the high points of his visit to Brazil where he delivered a series of lectures at the Institute of Technical Research, São Paulo, Brazil. It is expected President Dean Harvey and Secretary-Treasurer C. L. Warwick will speak briefly at the meeting. Announcements have been sent to all members in the Cleveland District. All technical men and those interested are invited to attend.

1943 Society Finances

SOME OF THE highlights and more interesting phases of the 1943 finances are given in the following summary of data submitted by the Secretary-Treasurer in his annual report to the Executive Committee at its January meeting. With the rapidly increasing appreciation of the significance of standards for engineering materials and of authoritative information on their properties—which in a sense are the two fundamental products of the Society—there have been corresponding developments of interest in the Society's financial picture. A detailed report covering financial operations will be included as usual in the Executive Committee's annual report to be presented to the Society at the Forty-seventh Annual Meeting in New York City, June 26–30.

1943 Receipts:

The total operating receipts for 1943 were an all-time high—$262,639—of which $111,256 was from dues and entrance fees; $132,169 from sales of publications, subscriptions, etc.; and $19,214 from miscellaneous items comprising principally advertising ($10,246) and income from investments ($4470).

Perhaps of chief interest in the analysis of receipts is the greatly increased income from sales of publications which is considerably higher than for any previous year and for the first time has exceeded income from dues. Two items account primarily for the total—the heavy demand for the 1942 Book of Standards, sales of which amounted to about $62,000, and the sales of special publications (including particularly special compilations of standards) amounting to about $42,000. A very considerable portion of these sales, of course, are to members for extra copies of various books; the total also includes the annual charges for furnishing members two or all three parts of the Book of Standards. This gratifying increase in the distribution of the Society's publications which began about four years ago at an increasing tempo has two important by-products—the increased knowledge of the Society's work and the application of specifications and tests in the preparation of which so many hundreds of our

members devote much time and effort in the technical committees.

The approximately ten per cent increase in income from dues over 1942 is a reflection of the growth in Society membership during the year including a substantial increase in the number of sustaining members.

Operating Disbursements:

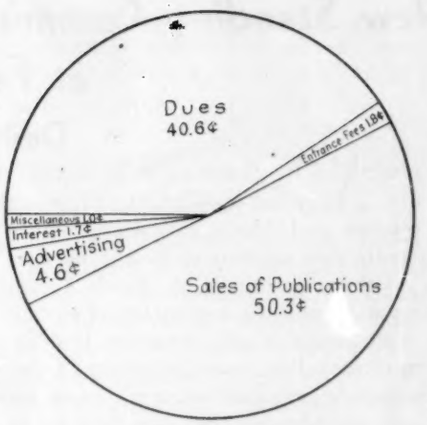
The disbursements totaled $231,900 leaving a favorable balance of just under $31,000. The expenditures include $93,100 for current publications and $15,000 toward the reserve for publication of the 1944 Book of Standards. The cost of special publications, symposiums and compilations of standards totaled almost $23,000. A substantial portion of publication costs involved Emergency Alternate Provisions on which for the past two years the Society has expended almost $9000, which constitutes a direct financial contribution in furtherance of the war effort through conservation of critical and strategic materials and expediting procurement.

Other items in disbursements include $2300, approximately one-half of entrance fees, paid into the research fund principal and about $4200 toward the Employees Retirement Fund, which includes five years' premiums on three retirement policies.

The favorable operating balance of $31,000 has been added to General Surplus where it will be used for needed expansion of Society activities in the future. This surplus is now about $105,000 which is less than half a year's operating expenses at present levels. It is interesting to note that while the *amount* of surplus has about doubled in five years, the significant *ratio* of surplus to current operating expenses has increased in that time only from 38 to 43 per cent.

Income Dollar and How Used:

As visual aids in grasping quickly a broad picture of A.S.T.M. 1943 finances, there are shown here two diagrams, one showing the source of the income dollar, the other how the income dollar was used. From the upper chart, one can determine quickly the percentage of income from dues, for example. A reference to the lower chart shows the large segment and consequently considerable percentage of the expenditures devoted to the Society's standardization work, one of its two major purposes. This, with the portion devoted to development and publication of data on properties of materials and testing, represents more than half of the expenditures. The portions devoted to membership and sales promotion and administrative expenses are somewhat lower than for 1942, while the surplus is considerably greater. Reference to the surplus has been made above.



Income Dollar

How Income Dollar Was Used

1944 Budget

In preparing the budget for 1944 the Executive Committee has continued its conservative policy in estimating receipts at $237,500. Of this amount $113,500 is expected from dues; $106,500 from sales of publications; $17,500 from advertising, interest and miscellaneous items. With disbursements estimated at $244,500 the budget is balanced by applying $7000 from surplus to current operations. Provision is made in the estimate of disbursements for necessary expansion of Staff to meet expected intensification of some phases of the work, and for the publication of the Book of Standards in 1944. Increased cost of printing, office expenses, and meetings are also provided for. War emergency expenses, such as emergency specifications work, are also included.

Creating New Jobs

A tremendous demand for glass could be created tomorrow by supplying Pittsburgh boys with plenty of rocks and having them break every window in the city. But no one would countenance such procedure even though it did provide a lot of jobs for glass workers. Yet that, in a sense, is what the waste of war does. Furthermore, there is no problem of creating demand or effecting equitable distribution in respect to war products. We give our shells away freely to Japs and Germans alike! All we have to do is to get one in our gunsights and the process of distribution starts automatically! But what would be a just formula by which a free people could give away glass, for example, to its citizens? It could certainly not be done fairly by creed or race or color. By charity? Yes, now and then when a tornado breaks the windows of every house in some village in the middle west. Well, someone might say, why not build more houses? That would require more glass. Yes, but who is to get the houses? How can they be given away equitably among our citizens? So far we have found only one practical way to proceed and that is to distribute to each man, in glass, or houses or anything else he wants, the equivalent of what he puts into the nation's economic pot through his own effort; not what that mystical thing the state (meaning you and me and all the rest of us) puts in, but what each individual himself contributes to the common pot of goods and services.

—*Quoted from H. W. Prentis, Jr., Armstrong Cork Co.*

New Standing Committee on Metal Powders Organized at February Meeting

Designated Committee B-9

ANOTHER NEW standing committee, B-9 on Metal Powders and Metal Powder Products, held its formal organization meeting in New York City on February 22. At this meeting W. A. Reich, General Electric Co., who was appointed temporary chairman, presided. Following an outline of considerations leading to the proposed committee, there was discussion of the scope, details of necessary personnel were reviewed and decisions reached, and considerable time was devoted to establishing a sound basis for subcommittee activities, since in the B-9 subcommittees, as with all A.S.T.M. standing groups, the greater part of the ground work will be laid for eventual recommendation to the main standing committee.

History and Scope:

For the past two or three years, with the very great expansion in use of metal powder products, notably for certain oil-less bearing applications but now used in a host of other strategic places, it has been repeatedly suggested to the Society that here was an important field for standardization work, particularly involving satisfactory methods of evaluating essential properties of both the powders and the resulting compacts. Partly with this interest in mind, the new Western New York-Ontario District Committee organized a Symposium on Powder Metallurgy, held in Buffalo just a year ago, with a resulting publication that has been of widespread interest. This intensified interest in a proposed standing committee led the Executive Committee to authorize its organization. There have been a number of preliminary discussions in order that there would be a clear conception of how the committee might best function and serve the industries concerned.

At the New York meeting it was decided the scope of the committee would be as follows: "The formulation of specifications and methods of tests for metal powders and metal powder products."

As with most standing committees, although there are some exceptions to the rule, this group will need to focus its early attention on satisfactory test methods since before specifications can be drafted it is usually necessary to have an agreed-on procedure for evaluating the properties established in the purchase specifications. Some committees have devoted years of effort to perfecting test methods before the specifications could be drafted, although it has been possible in the case of some of the committees to cut down the time interval between publishing test methods and issuing purchase specifications, for example, Committees C-16 on Thermal Insulating Materials and D-20 on Plastics.

Officers:

In selecting officers of the committee, A.S.T.M. regulations require that the chairman be from the consuming or general interest group. W. A. Reich, Works Laboratory, General Electric Co., Schenectadv. N. Y.. had been appointed temporary chairman, and W. R. Toeplitz, Bound Brook Oil-less Bearing Co., Bound Brook, N. J., temporary secretary. Both men have had extensive experience in the field and are following various details closely. At the meeting which was opened by the two men as temporary officers they were elected as permanent chairman and secretary for one year. Serving with them on the Advisory Committee, which is charged with the administration of the work, are the chairmen of the subcommittees as noted below.

Subcommittees:

A considerable portion of the discussion at the meeting concerned the subcommittee structure and just how best these could be organized and function. After all angles were considered, the following subcommittees were established:

Subcommittee I on Nomenclature and Technical Data—*Chairman*, F. N. Rhines, Carnegie Inst. of Technology, Pittsburgh, Pa.

Subcommittee II on Metal Powders—*Chairman*, D. O. Noel, Metals Disintegrating Co., Inc., Elizabeth, N. J.

Subcommittee III on Metal Powder Products—*Chairman*, R. P. Koehring, Moraine Products Div., General Motors Corp., Dayton, Ohio.

The two latter subcommittees are to be responsible not only for such specifications as may eventually develop but also for test methods.

One of the early problems of Subcommittee I is the compilation of technical data on standard materials and possibly the preparation of this in the form of data sheets. In the work on metal powders, Subcommittee II, some recognized tests have been developed by users and producers of powders, all of which will be considered by the subcommittee.

Committee Personnel:

The A.S.T.M. policy of arranging the personnel of its technical committees to include qualified technical repre-

W. A. Reich W. R. Toeplitz

sentatives of leading producers, consumers, and general interest groups continues with Committee B-9. The personnel of the committee, as organized, is as follows:

Committee B-9 on Metal Powders and Metal Powder Products

CHAIRMAN: W. A. REICH, General Electric Co., Schenectady, N. Y.
SECRETARY: W. R. TOEPLITZ, Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.

P American Metal Co., Ltd.
Paul Weingart
*P-C C. W. Balke (Fansteel Metallurgical Corp.)
C Bell Telephone Laboratories-Inc.
I. V. Williams
C Bendix Aviation Corp.
S. S. Kingsbury
P-C C. J. Bier (Henry L. Crowley & Co.)
P-C Carboloy Co., Inc.
E. W. Engle
GI Carnegie Institute of Technology
F. N. Rhines
P-C Chrysler Corp.
A. J. Langhammer
P-C Cleveland Wire Works, General Electric Co.
W. P. Sykes
GI Columbia University
C. G. Fink
P J. E. Drapeau, Jr. (Metals Refining Co.)
C Eastman Kodak Co.
Gordon B. Cowles
C C. W. Fabel (Curtiss-Wright Corp.)
C Ford Motor Co.
E. E. Ensign
C General Electric Co.
W. A. Reich
P-C A. B. Gibson (Gibson Electric Co.)
GI Charles Hardy (Hardy Metallurgical Co.)
P-C F. R. Hensel (P. R. Mallory & Co., Inc.)
P-C Keystone Carbon Co., Inc.
W. P. Gies
P-C R. P. Koehring (Moraine Products Div., General Motors Corp.)
P-C Manhattan Rubber Mfg. Div. of Raybestos-Manhattan, Inc.
C. S. Batchelor
P-C National Carbon Co., Inc.
M. R. Hatfield
C National Cash Register Co.
H. M. Williams
P New Jersey Zinc Co. (of Pa.)
E. H. Kelton
P D. O. Noel (Metals Disintegrating Co., Inc.)
GI Ontario Research Foundation
O. W. Ellis
P Phelps Dodge Corp.
W. H. Osborn
P Plastics Metals, Inc.
B. T. du Pont
P-C R. P. Seelig (Powder Metallurgy Corp.)
C Sperry Gyroscope Co., Inc.
R. W. Waring
P-C Stackpole Carbon Co.
L. D. Andrews
GI Stevens Institute of Technology
G. J. Comstock
P-C C. E. Swartz (Cleveland Graphite Bronze Co.)
P-C W. R. Toeplitz (Bound Brook Oil-Less Bearing Co.)
P-C D. S. Urquhart (United States Graphite Co.)
C U. S. Navy, Bureau of Ships
C U. S. War Dept., Ordnance Dept.
J. H. Frye
P-C S. K. Wellman Co.
J. R. Nurney
C Westinghouse Electric & Mfg. Co.
P. R. Kalischer

* The members classified as P-C stand in the relation of producer to certain products and in that of consumer to other products within the province of the committee.

More on Building Codes

AMONG THE interesting articles in the first issue of the new *Journal of The American Institute of Architects*, which is termed a "broadcasting system operating on the wave length of the voice of the profession," is a paper by Walter R. MacCornack on "Let's Stop Tinkering with Building Codes," in which there is advocated a national standard for code writing to extricate us from the chaotic conditions which, it is rather generally agreed, hold. The proposal embodies the creation of a code for an entire state thus simplifying the system throughout the state, and appointing a board of standards and appeals by which the code could be changed promptly, thus permitting the use of new materials and construction after proper scientific tests have been evaluated.

"Mechanical Properties of Metals and Alloys"

A MOST VALUABLE 480-page book has just been issued as Circular C 447 of the National Bureau of Standards, entitled "Mechanical Properties of Metals and Alloys", prepared by various members of the Bureau's staff. The manuscript was carefully read by a number of authorities, several men not Bureau staff members being asked to comment critically. Essentially the book is a summary of the results of a comprehensive survey of the technical literature on the strength and related properties, thermal expansion, and thermal and electrical conductivities of ferrous and non-ferrous metals and alloys at normal, high, and low temperatures. In general, the data are presented in tabular form, although graphical representation is often used to indicate the effects of changing composition or conditions on the properties. Data on aluminum, copper, iron and steel, lead, magnesium, nickel, tin, zinc, a number of miscellaneous metals, and their alloys are included. The Circular is not limited to conventional engineering materials but contains data on the properties of many materials not usually classed as such. Literature references to the sources of the data are included.

All told, there are 4172 metals and alloys listed in the 66 very extensive tables. Well-prepared charts and diagrams supplement the tables with pertinent information, there being 209 such figures. Prefacing the tabular data is a section describing the development of the information, portion on definitions including heat treatment terms, powder metallurgy terms, etc.

In so far as possible data from actual tests are given rather than the specification or average properties. For each value of a property, the source is given in a literature reference, the bibliography including 724 items of which as one might expect a very large number are from A.S.T.M. publications.

Here indeed is a book which should be in the reference files of everyone concerned with the field of metals and alloys. Copies, cloth bound, page size 8 by $10^1/_2$ in., can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., at $1.50.

Bulletins May Be Tardy

THE LATE publication and distribution of the January ASTM BULLETIN had only one comforting aspect—the number of requests and inquiries we had all falling under the general query, "Where is my copy of the January BULLETIN?" We were pleased to note how many missed it. About the middle of February most of those queries were answered through the receipt of the publication itself. This March issue will reach members and subscribers also somewhat late, but it is hoped that with succeeding issues we can more nearly make the established deadline. Apparently all editors, publishers, and printers have been pretty much in the same backwash from the old steamboat—"Very Heavy Production."

"Grex" Universal Yarn Numbering System

By A. G. Scroggie[1]

THE USE, in the textile industry, of various yarn numbering systems based on hanks, cuts, runs, leas, typps, deniers, spyndles, etc., has caused trouble for many years. This confusion has become more intense recently with the penetration of yarns like rayon, nylon, Vinyon, and Fortisan into the older cotton, linen, woolen, and worsted mills.

The difficulties caused by the use of various *unrelated* yarn numbering systems warrant the textile industry making a serious attempt to establish a *universal* yarn numbering system, and the standing committee on textiles of the American Society for Testing Materials is currently considering, for this purpose, the "Grex"[2] unit defined as grams per 10,000 meters.

The "Grex" Unit:

The "Grex" is a DIRECT unit based on "weight per unit length." Direct systems are currently used by the silk, rayon, nylon, Vinyon, Fortisan, and jute industries. Direct units are also used by the cotton, linen, woolen, and worsted industries, for *tops and slivers*, and for the measurement of *individual* fibers.

The "Grex" numbering system has a number of advantages over length per unit weight (reciprocal) systems, as noted below.

1. Numbers can be determined by direct weighing and with a minimum of calculation when meter lengths are weighed in grams.

2. It has a large number for coarse yarns and cords, a small number for fine yarns, and unit numbers for single fibers or filaments. This avoids the use of unwieldy numbers for fine filaments. A one-denier filament yarn, for instance, is number 5315 cotton count or 14,882 woolen run.

3. A specific yarn number difference has the same value at all parts of the scale and not a variable value, as in reciprocal systems.

4. The equivalent single yarn number of plied and corded structures can be approximated[3] by direct addition of the numbers of the single yarns, whether or not they are of the same fineness. This avoids the complicated formula needed for all reciprocal units.

5. Extension of the system to include a Kilogrex unit (1000 "Grex") provides a satisfactory measure for handling cords, rovings, tops, etc. These are not normally measured in regular cotton counts, woolen runs, etc., because of the small decimal fractions obtained for comparatively heavy structures.

6. Single wool fibers and cotton seed hairs are generally measured in microns (direct metric units, not in hanks, cuts, or runs). Using the known density of the fibers, widths in microns could be recorded in terms of "Grex" units, thus relating fibers directly with yarns. This is currently done in rayon staple where the 1.5 denier size is in common use.

7. The use of any universal, readily decimalized, direct unit, which covers this wide range from fiber to sliver, would facilitate control of yarn fineness in any mill spinning yarn from fibers, since the adjustments required in laps, slivers, or draft to correct variations in finished yarns will be strictly proportional to the variation observed in the yarn.

8. Strength can be expressed conveniently in grams per grex, which is readily measured. This avoids the comparatively awkward thousands-of-pounds-per-square-inch, of hypothetical nonexistent structures.

Difficulties to be Expected During Changeover:

It is conceded that the introduction of any universal yarn numbering system will cause more or less trouble for a short time, particularly in the cotton, woolen, worsted, and other industries, if a direct unit is established, and it is probable that no one system will prove ideal for all branches of the textile industry. It is contended, however, that the physical changes would not be difficult to effect, since all operations now connected with yarn numbers could be changed by the use of specially prepared yarn conversion tables. These are easily and cheaply made. Testing instruments could be changed on a new or replacement basis if desired, and old and new units could be used during a transition period to insure a minimum of misunderstanding.

It is believed that the temporary difficulties would be a small price to pay for the advantages which would be secured and the troubles that would be eliminated in the indefinite future. The effort that will have to be made,

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[1] Chairman Subcommittee B-2 on Nomenclature and Definitions of A.S.T.M. Committee D-13. Address—E. I. du Pont de Nemours & Co., Box 1477, Richmond 12, Va.

[2] The term "Grex" (plural grex, abbreviation gx.) is derived from

GRams pEr 10,000 meters
GR . . . E . . X

[3] Results must be modified for twist take-up, regardless of the system of calculation.

TABLE I.—COMPARISON OF PROPOSED "GREX" UNITS, AND OTHERS NOW IN COMMON USE.

Universal Grex Grams per 10,000 m.	Woolen Run 1600 yds per lb.	Cotton Hank 840 yds per lb.	Worsted Hank 560 yds per lb.	Linen Lea 300 yds per lb.	General Typp 1000 yds per lb.	Rayon Denier Grams per 9000 m.	General Grains per yd.	Jute Spyndle Pounds per 14,400 yd.
1	3100.34[1]	5905.41[1]	8858.11[1]	16535.15[1]	4960.55[2]	0.9	0.0014	0.0029
100	31.00	59.05	88.58	165.35	49.61	90.0	0.14	0.290
200	15.50	29.53	44.29	82.68	24.80	180.0	0.28	0.580
1000 (1 Kgx)	3.10	5.91	8.85	16.54	4.96	900.0	1.41	2.903

[1] Calculated from $\frac{4,960,545}{\text{Yds. per hank (run) (lea)}}$ = Yarn number.

[2] Calculated from 10,000 × 1.09361 × 453.59243 = 4,960,545.6 yds. per lb.

however, does demand that a careful review of existing and proposed systems be made, to be sure that the best possible system is being adopted.

Why Not Adopt the Direct Spyndle or Denier Units?

In considering this proposal, the general adoption of an existing direct unit such as the spyndle or denier has been considered. However, the spyndle unit, equivalent to pounds per 14,400 yards, cannot be readily decimalized, and the numbers of normal textile yarn are decimal fractions, which is undesirable. The denier unit has most of the advantages of the "Grex"; it is, however, based on 9000 meters and multiples or submultiples are not quite as easy to handle. (For instance, 90 cm. or 1.8 meter lengths and reels of 1.125 m. are in common use.) It is also desirable, of course, that in view of the trouble involved in effecting a changeover, nothing short of the best possible system be adopted.

The Merits of the "Grex" Justify Action:

From the foregoing, it will be seen that the "Grex" has much to recommend it. It is direct, it is mathematically simple, it is euphonious, it is based on principles familiar to men in every branch of the textile industry. The advent of new synthetic yarns makes it very appropriate that a universal numbering system be adopted as soon as possible.

The accompanying Table I, gives a comparison of the proposed "Grex" units and other units in common use.

New Edition of British Petroleum Methods

THE 1944 EDITION of the "Standard Methods for Testing Petroleum and Its Products" has just been issued by the British Institute of Petroleum and copies of this greatly enlarged publication can be obtained from A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa., which acts as a distribution point for the publication at $3 per copy, postage prepaid. Compared to the 1942 edition which was a completely reset book because of loss of type during the London "blitz," the latest edition is larger by more than 100 pages. A number of additional methods are given particularly relating to derived chemicals, asphaltic bitumen emulsions, thermometers, etc.

Many of the methods approved by the Institute of Petroleum are identical or in relatively close agreement with A.S.T.M. procedures and the methods as published indicate this status. The book includes a list of committee personnel, report of the Standardization Committee, and a detailed index.

A.S.T.M. has been pleased to cooperate in maintaining a stock of the books for prompt distribution in the United States. The Institute of Petroleum at its London headquarters, 26 Portland Place, London, W.1., endeavors to keep a stock of several A.S.T.M. publications relating to the petroleum field including the A.S.T.M. compilation of standards, viscosity temperature charts, Report on Significance of Tests, etc.

Underwriters' Laboratories Commemorates Fifty Years' Service

ON MARCH 24, 1894, THERE was issued Report No. 1 by the Underwriters' Laboratories. This covered the investigation of an electrical insulating material. Since that time the work of this organization has expanded almost unbelievably, and its testing, inspection, and related work is known in every nook and cranny where materials are used. Throughout its fifty years' service the main objective of the laboratories has remained essentially the same—to reduce the danger to life and property. Three hundred seventy-five thousand products have been approved by the laboratories and many more have been tested because many fail to receive first approval. Its inspection labels are well known, and to carry out all of the work a corps of technically trained inspectors operate from some 185 centers of production throughout the world. For the past three years the work has been expanded to include many special war activities.

In A.S.T.M. the Underwriters' Laboratories have rendered active service, maintaining an organization membership for over 25 years represented by A. H. Nuckolls, Chemical Engineer, Chicago, and three individual memberships—A. R. Small, President of the Laboratories; R. B. Shepard, Chief Electrical Engineer; and H. M. Robinson, Service Engineer. Mr. Robinson serves as Secretary of A.S.T.M. Committee C-5 on Fire Tests of Materials and Construction. The Society has been pleased to extend congratulations and best wishes to the Laboratories in connection with their fiftieth anniversary.

Engineers' Spanish-English Dictionary

OCCASIONALLY, engineers with widespread experience will prepare on the basis of their activities and records, publications that are of widespread interest and service to their fellows. In this general class is the new "Engineers' Dictionary of Spanish-English; English-Spanish" by Louis A. Robb, Vice-President, Ambursen Engineering Corp. The material has been accumulated over a period of more than 25 years and provides over 44,000 current technical Spanish-and-American engineering terms with their local variations as used throughout Latin America. The author points out that when he first started work there was no really satisfactory technical dictionary to cover the terms with which his organization was confronted. The present volume primarily covers the vocabulary of civil engineering with many mechanical and electrical terms as well as some on geology, chemistry, and allied sciences. The terminology of Spanish-America differs from that of Spain, and there is considerable variation in the use of words among the 18 Spanish-speaking republic themselves. For example, *Hormigonera* and *mezcladora* are the usual words everywhere for *concrete mixer*, but in Venezuela it is sometimes *terceadora* and in Mexico it is sometimes *revolvedora*. Others of these local expressions are practically always used by engineers in the designated countries. *Usina*, meaning *powerh-use*, is peculiar to Argentina, Uruguay, and Bolivia, but in those countries it is the generally accepted term.

Copies of this publication should be of definite help to anyone having contacts with the Spanish language. It is available from the publishers, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., at $6.00 per copy.

(Committee Week)

(Much Work in Progress)

(*Continued from p. 16*)

pletion covering wrought products (hot-rolled and cold-drawn bars) with tolerances and physical and chemical requirements. Also nearing completing is a specification for stainless spring wire.

At the request of the Boiler Code Materials Committee studies are being made of possible chemical changes in the specification for plate, sheet, and strip for welded pressure vessels (A 240).

Excellent progress was reported in the completion of four prospective specifications covering stainless tubing for various applications, including austenitic seamless and welded for general service, also ferritic alloys for the same type of service, and materials for cracking stills, and a further application would be in the dairy and food industries.

Two other projects under way in the committee include a study of standard requirements for the 25–12 alloy castings and preparation of a procedure suitable for stainless compositions of the total immersion corrosion test of non-ferrous metals and alloys (B 185).

Proposed Atmospheric Exposure Test Program:

F. L. LaQue, chairman of the subcommittee on corrosion testing announced that tentative plans on the new program provided for the use of some six chemical compositions in the form of strip, but for the 18–8 grades to include also hard-drawn wire and aircraft control cable and, probably, seamless tubing. The grades proposed for inclusion are as follows: 13 Cr (Type No. 410), 17 Cr (430), 17 Cr–7 Ni (301), 18 Cr–8 Ni (302), 18–8 (316) moly., and 18 Cr–4 Mn–4 Ni. Fatigue tests will be run on the wire specimens, annealing will be used to avoid aging effects, and for some specimens some type of deformation will be set up to judge this effect.

The corrosion damage in the various test sites representing marine, industrial, and rural atmospheres will be judged by examination of various mechanical properties in comparison with unexposed stock samples carefully maintained under noncorroding conditions. The plan is to bring in certain of the specimens after 3, 7, and 15 years' exposure.

Corrosion of Non-Ferrous Metals and Alloys

A most important aim of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys is to develop satisfactory methods for evaluating the corrosion-resisting properties of the wide range of non-ferrous metals and alloys, and in line with this aim a study committee has been appointed to consider the applicability to non-ferrous metals of the Recommended Practice for Conducting Plant Corrosion Tests of Stainless Steels (A 224).

There is intense interest in the Salt Spray Test, B 117, and a conference is to be organized with various representatives present including people from the various branches of the armed services, to discuss proposed changes in this procedure.

The committee, in its various reports, has issued valuable data resulting from its country-wide atmospheric exposure test programs. The 1944 report will include a considerable amount of additional data resulting from tests of tension test specimens cut from sheets which have been on exposure at the test site atmospheres for some ten years.

One of the most extensive research investigations carried on by the Society involved the galvanic and electrolytic couple tests on which a final report was published in the 1939 A.S.T.M. *Proceedings*. These data provide an authoritative picture of the results from "coupling" various non-ferrous metals and alloys. A new test program is now being developed, one of the phases of which would cover couples of magnesium and its alloys with other metals.

Copper and Copper Alloys, Cast and Wrought

Important changes in many of its specifications will be proposed as a result of the Cincinnati meetings of Committee B-5 on Copper and Copper Alloys, Cast and Wrought, and several new proposed standards are expected to be offered to the Society at its annual meeting in June in New York, including three specifications for beryllium copper, with a nominal beryllium content of 2.05 per cent, covering wire, bar and rod, and sheet and strip.

Changes in the copper and lead limits of brass sheet and strip (B 36) and the same materials, leaded (B 121) are proposed in order to have these requirements more in line with those now commercially available. Also changes in tensile strength and Rockwell hardness values are being proposed in the specifications covering cartridge brass, sheet, and strip (B 19). A special subcommittee was appointed to study Specifications B 152 for copper sheet, strip, and plate in order to divide it into two specifications, one for plate and the other for sheet and strip.

In connection with the use in quite a number of product specifications of fire-refined copper (Braden) emergency alternate specifications (ES 7) had been established which the committee now feels can be withdrawn by incorporating this particular grade of copper as a permanent part of several wrought copper specifications.

For some time the committee has been studying problems involving dimensional tolerances in its product specifications and has now decided to make various changes in order that the requirements will be in line with current manufacturing practice.

An emergency provision establishing modified chemical composition for free-cutting brass rod is to be submitted. This establishes definite limits on tin (0.30), nickel (0.50) and raises the maximum permissible iron from the present specification requirement of 0.15 to 0.35 per cent. With this change the provision will be in line with an amendment to certain Federal specifications (see page 56).

A special section has been developing standard requirements for copper bus bars, rods, and shapes, and also bus pipes and tubes, this material being used for electrical

conductors. For each material several ranges of physical properties with corresponding electrical requirements are set up, accompanied by the necessary requirements on methods of testing, finish, etc.

At the meeting there was discussion of the proposed technical symposium on so-called season cracking of nonferrous metals and alloys in which various technical authorities would present discussion, the symposium to be a feature of the Society's Annual Meeting in New York City in June.

Die-Cast Metals and Alloys

Committee B-6 on Die-Cast Metals and Alloys reviewed its widely used specifications for various types of die castings. A significant editorial change in the title and nomenclature of the Emergency Specifications ES 28 was made so that instead of "pressure molded castings" this will be termed "controlled quality die castings." The general style and arrangement of this standard which covers aluminum-base materials will be followed in rearranging the style of the Tentative Specifications for Special Grade Zinc-Base Alloy Die Castings (B 186 – 42 T). The standard covering lead and tin-base alloy die castings with five alloy grades (B 102 – 39 T) is to be recommended for adoption as a formal A.S.T.M. standard, while the requirements for copper-base brass castings (B 176) are to continue as tentative specifications.

A special group has been appointed to review all of the specification requirements for aluminum die castings in order to coordinate these with Government specifications, particularly with respect to limitations on minor elements.

Atmospheric Exposure Tests:

Committee B-6 has had under way very extensive outdoor corrosion tests of various types of die casting alloys and this year will bring in from the widely scattered ten test locations specimens of the twelve aluminum alloys which have been exposed for 15 years and also specimens of the zinc alloys. Three special quality aluminum alloy grades were included in tests at three outdoor locations and specimens of these will be evaluated after ten years' exposure. In order that its data will be as valuable as possible, the committee has, during the test program, exposed other alloys which were more nearly in line with latest commercial production, and three zinc and four magnesium grades which have been on test for five years at the ten sites are to be reported on.

To meet the current need for requirements on controlled quality magnesium-base die castings, emergency specifications have been completed and are to be referred to committee letter ballot.

It was announced that an extension of the exposure tests is planned to include brass die castings, the program for the casting of these having been established. At present a survey is under way dealing with the proper die steels for use in casting brass compositions. It is hoped that a technical paper on this subject will be completed soon.

Electrodeposited Coatings

Not only has Committee B-8 on Electrodeposited Coatings developed a number of important specifications and tests in this field, but it has an extensive program of atmospheric corrosion exposure tests under way involving lead coatings on steel. Some 600 exposure panels are included in the work with the thickness of the electrodeposited lead varying from 0.000085 to 0.001 in. in thickness. Two different kinds of baths are being used for preparation of the specimens. Also included in the work are control panels of electrodeposited and hot-dip zinc coatings and hot-dip lead coatings. Exposure sites include different types of atmospheres with test racks at New York City; State College, Pa.; Kure Beach, N. C ; Tela, Honduras. Another project being undertaken in the committee involves the fundamental study of corrosion through pores of electrodeposited coatings, and a special section is being appointed

In its work involving specification requirements for electrodeposited coatings, Committee B-8 has worked closely with other interested organizations and other standing committees of the Society. A list of the specifications and recommended practices all of which the committee decided would continue in their present form is as follows: Electrodeposited Coatings of Zinc on Steel (A 164), Cadmium on Steel (A 165); Nickel and Chromium (A 166); Nickel and Chromium on Copper and Copper-Base Alloys (B 141); Nickel and Chromium on Zinc and Zinc-Base Alloys (B 142); Lead on Steel (ES – 31); Local Thickness of Electrodeposited Coatings (A 219); Preparation of Low-Carbon Steel for Electroplating (B 183); and Chromium Plating Steel for Engineering Use (B 177).

Cement

(Meeting of Committee C-1 on Cement, Allentown, Pa., March 3-4)

Subject to letter ballot, the committee decided to present a number of recommendations on standards, including important new test methods, the principal items being briefly outlined below.

The Standard Methods of Sampling and Physical Testing of Portland Cement (C 77 – 40) were revised in places and separated into the principal constituent parts, to be offered as separate methods in order to facilitate their use.

The test for compressive strength of portland-cement mortars (C 109 – 37 T) was modified and approved for advancement to standard The changes include the use of the flow table, as in the Government specifications, to determine the amount of mixing water to be used in the test mortars.

The changes in chemical methods included recommended adoption as standard of the following five tentative methods now in C 114 – 42 T: Methods A and B for determining free calcium oxide in portland cement; rapid alternate method for silicon dioxide determination; rapid alternate method for determining calcium oxide; rapid alternate method for determining magnesium oxide. The Standard Method for Chemical Analysis of Portland Cement (C 114 – 42) was revised so as to secure better arrangement, closer conformity to A.S.T.M. editorial procedure, and

include the above five methods which are being advanced from tentative to standard status. A method for determination of Vinsol resin in cement was approved for submission as a new tentative standard.

A method for determining the heat of hydration of portland cement was approved for submission as a new tentative method.

The Standard Specifications for Portland Cement, C 150, are to be revised in a number of places.

Tentative Specifications C 175 were revised, with the title now changed to read "Tentative Specifications for Air-Entraining Portland Cement for Concrete Pavements." This revision includes limits on the amount of air entrained in a 1:4 mortar when tested according to a procedure which was approved for separate submission as a new tentative test method.

The various subcommittees reported on the status of their recent and current activities. There was lengthy discussion of recent studies of air-entraining portland cements, considerable data being offered (see page 22). A report was made on the current series of cooperative fineness tests in which more than thirty laboratories are testing six cements to obtain data on the nature of the agreement in their results when using the Blaine fineness meter and the Wagner turbidimeter.

Steps were initiated to secure the appropriate revision of the Manual on Cement Testing prior to the June meeting of the Society, in New York.

Thermal Insulating Materials

At the various subcommittee meetings and main session of Committee C-16 on Thermal Insulating Materials, the several regular and emergency specifications and test methods were reviewed, particularly from the standpoint of desirability of adopting some as standard and changing some of the emergency items from this status to regular A.S.T.M. tentative standards. The committee has issued twelve emergency specifications for various types of materials, six tentative test methods also have been issued, and a set of definitions of terms have been in existence for three years. Three of the tentative methods pertaining to insulating cement—sampling and mixing (C 163), bulk density (C 164), covering capacity and volume change (C 166)—are to be submitted to ballot for adoption as standard; also definitions (C 168) and the test for thickness and density of blanket (C 167). It is announced that a proposed standard setting up requirements for insulating board was nearing completion.

Concerning the emergency specifications, eight are considered suitable for approval as regular tentative specifications and will also be referred to ballot. The five emergency specifications for thermal insulating cement are as follows: 85 per cent magnesia (ES – 8), asbestos, long fiber (ES – 9), mineral wool (ES – 10), mica (ES – 11), and diatomaceous earth (ES – 12); also three specifications covering blanket thermal insulation for building (ES – 14), industrial purposes (ES – 15), and refrigeration purposes (ES – 16).

At the meeting there was detailed discussion on revision in the By-laws providing for regularity of attendance, question of dimensional standards, and the responsibility of the committee in connection with launching of work on vapor barriers.

Paint, Varnish, Lacquer, and Related Products

During the last few years extensive changes have occurred in the commercial supply of drying oils The Society through Committee D-1 on Paint, Varnish, Lacquer, and Related Products is instituting investigations to revise and amplify its methods of test as necessary to cover the situation; also to write specifications for the properties of acceptable grades of the new oils. In the volatile liquids used for thinning paints, varnishes and lacquers, there has also been a marked expansion in the field. A new group has been formed in Committee D-1 to develop suitable tests and property specifications for these.

The committee is developing an extensive set of methods for testing a comparatively new class of rapid drying and wear-resisting paints which are used for traffic markings on various kinds of pavements. Part of these have already been published (D 711, D 712, D 713 — Pick-up-Time, Light Sensitivity, and Road Service Tests) and more are being prepared. The committee continues its study of the very difficult subject of methods of accelerated tests of paint, varnish, lacquer, and similar coating materials, to determine their durability much more quickly than by ordinary service trial. This study covers both apparatus and methods for these tests.

Varnish is another material which is in a state of rapid change and development. At the same time it involves some new problems, not only in chemical analysis, but also in testing the final physical properties, which are influenced not only by chemical composition, but also by details of the manufacturing processes. The accurate determination of the drying time of some varnishes and paints is really a difficult problem and is being carefully investigated. Methods are developing for determining melting points, viscosity, color, and acid number of synthetic varnish materials.

The wide range in luster, from dead flat to high gloss as well as the many colors and shades of organic coatings, has necessitated methods for testing these properties by precise optical processes. An instrument and method adopted tentatively has now been found satisfactory and is made standard for the measurement of color and shade (D 307). Methods for measuring gloss previously adopted tentatively (D 523) are being further studied. These methods are now supplemented by one for measuring the 45 deg. reflectance of painted surfaces. Further developments are methods for determining melting points, viscosity, color, and acid number of synthetic varnish materials.

The correct and understandable appraisal and record of the condition of coatings which have been in service is important. Already photographic reference scales of the degree of failure of coatings by rusting (painted steel) (D 610) and by checking, cracking, chalking, and wear of ordinary surfaces (D 659 to D 662, incl.) have been developed. These are being extended to the traffic paints. A test for the resistance of these latter paints to staining by absorption of colored material from underneath is being developed. To these methods are being added apparatus

and procedure for the precision testing of the hiding power and day and night visibility of traffic paints.

A recently completed investigation on methods for treating steel surfaces preparatory to painting is being supplemented by some additional tests.

Committee D-1 has extended its list of specifications for pigments of the iron oxide class, by the addition of Venetian red, raw and burnt umber, raw and burnt sienna, also the new, artificial yellow and black iron oxides.

Petroleum Products and Lubricants

An informal Symposium on Sulfur Determination and important actions on new and revised standards highlighted the Cincinnati meetings of Committee D-2 on Petroleum Products and Lubricants. At the Symposium, held Friday afternoon, March 3, the following four papers were presented, describing several new and improved methods now being studied for determining sulfur: Quartz Tube Method for Determination of Sulfur Content of Low Volatile Products, Louis Lykken, Shell Development Co.; The Use of the Parr Photoelectric Turbidimeter, Julian Alexander, Catalytic Development Co.; The Vertical Combination Tube Method, E. P. Rittershausen, Socony-Vacuum Oil Co.; Further Refinements of the Lamp Sulfur Method, Louis Lykken.

Committee D-2 has just completed four new emergency methods and one emergency alternate provision which it is expected will shortly be published. They cover determinations for certain elements in lubricating oils, such as, chlorine (by bomb methods); phosphorus, lead, copper and iron; other metals; and as an emergency alternate provision, a test for sulfur by the bomb method (see page 37).

Studies continued very actively on the Method of Test for Neutralization Number by Color-Indicator Titration (D 663), and by Electrometric Titration (D 664). Based on test data obtained by eight cooperating laboratories and further experience with these methods, they are being revised, including new titles to indicate that they cover tests for determining acid and base numbers of petroleum products.

Decision was reached for Aniline Point (D 611) to include in the test a procedure for determining the aniline point of high-solvency petroleum fractions using *n*-heptane as the diluent. Before recommending the addition, a series of cooperative tests were carried out in several laboratories.

Among the standardized test methods in which revisions will be recommended are the test for Consistency of Lubricating Greases and Petrolatum (D 217), Rust-Preventing Characteristics of Steam-Turbine Oil (D 665), Sulfur in Petroleum Oils (Bomb Method), (D 129) and the Test for Gum Content of Gasoline (D 381).

The committee has reviewed the various specifications and test methods under its jurisdiction and action was taken at the meeting to recommend to the Society for adoption as standard the following four tentative standards. Saponification Number by Color-Indicator Titration (D 94), Knock Characteristics of Motor Fuels (D 357), Conversion of Kinematic Viscosity to Furol Saybolt (D 666), and Test for Oil Content of Paraffin Wax (D 721).

The committee plans to recommend to the Society in June the withdrawal of the Tentative Specifications for Aviation Gasolines (D 615 – 41 T) since they do not at present represent current practice for this type of gasoline.

The Proposed Method of Test for Potential Gum in Aviation Gasoline, published in draft form as information in 1942, has been further revised and it is expected will again be published for the purpose of soliciting further comments and suggestions.

Road and Paving Materials

At the meeting of Committee D-4 on Road and Paving Materials, agreement was reached on a proposed test method for the heat extraction of asphaltic materials and the recovery of bitumen, the process used being a modification of the Abson method. The committee in charge has been investigating this problem for the past three years, and considerable cooperative work has been carried out. The method involves a heat extraction procedure, centrifuging to remove the fine mineral matter, and a standardized distillation procedure using CO_2 resulting in the recovery of relatively ash-free bitumen. The new method, when issued will include a clarifying note that the test has been studied for asphaltic materials not softer than 150 penetration.

Several existing tentative standards in the charge of the committee are to be adopted as standard, including the requirements for Crushed Stone and Crushed Slag for Bituminous Macadam Base and Surface Courses of Pavements (D 693) and for Crushed Stone, Crushed Slag and Gravel for Water-Bound Macadam Base and Surface Courses of Pavements (D 694).

Although volume correction tables for creosote and coal tar (D 347) have been adopted as standard for a number of years, the volume correction tables covering coal tar pitch (D 633) have been tentative since 1941. Committee action recommends adoption of these tables as standard.

A subcommittee on distillation will study the test method for Distillation of Cut Back Asphalts (D 402) with regard to rate of distillation, type and size of apparatus used.

Coal and Coke

Matters on which action was taken by Committee D-5 on Coal and Coke at its Cincinnati sessions, include the proposal to adopt as standard the tentative definitions of the terms "gross calorific value" and "net calorific value" on which there has been considerable discussion recently; the adoption as standard of the explanatory note concerning the determination of ash in coals unusually high in pyrite and calcite; and the adoption of those revisions involving designating the size of coal from its screen analysis (D 431). These latter changes involve the indication of size ranges by giving the upper limiting screen first, and certain editorial modifications.

Progress was reported in sampling coal for determination of volatile matter in connection with city smoke ordinances and also in the work on plasticity and swelling where comments have been received on the several methods published for information in the 1943 report.

Because active test work is under way which may lead to changes in the tentative test for grindability of coal by the Hardgrove-machine method (D 409) and the Ball-Mill method (D 408), these are to be retained as tentative. The committee is following various reports and papers dealing with testing and sampling procedures involving coal and coke and in this category will consider a recent survey of analysis of anthracite by different laboratories which bears on the tolerances of volatile matter.

Electrical Insulating Materials

(Meeting of Committee D-9, Philadelphia, February 21 and 22)

Publication of the latest compilation of A.S.T.M. Standards on Electrical Insulating Materials, a 500-page book, indicates the extent of the research and standardization work in this field. At its Philadelphia meeting, Committee D-9 completed proposed new specifications for shellac for electrical purposes, emergency specifications for communication line pin-type lime-glass insulators, and also approved the submission through proper channels of a number of changes. Important revisions in the Standard Methods of Testing Sheet and Plate Materials Used in Electrical Insulation (D 229 – 43) include a test procedure for dielectric strength parallel with laminations, a revised Rockwell hardness test to be published as a new tentative method (this method will be under the joint jurisdiction of Committees D-9 and D-20 on Plastics), and a test for linear thermal expansion. Other actions involve the inclusion in the methods of testing electrical insulating oils of revised procedures for determining dielectric strength, particularly preparation of the samples used. A summary of the work in recent years on dielectric strength of insulating oils is to be published in some form.

A number of tentative test methods which have been published for several years are to be referred to the Society for adoption as standard—these cover determination of such properties as punching quality, product uniformity (D 617, D 634), and dimensions of rigid tubes (D 668); and tests for filling and treating compounds (D 176). In connection with filling and treating compounds, purchase specifications are to be drafted.

Announcement was made of the forming of a new subcommittee on mechanical tests which will study a number of new proposals in this field for determining properties of electrical insulating materials.

Rubber Products

At the Cincinnati meetings of Committee D-11 on Rubber Products, which had fostered the extensive Symposium on Applications of Synthetic Rubbers, numerous actions were taken on new and revised standards. The committee's specifications and tests have been widely used in the war effort, and strenuous efforts were made through emergency standards and provisions to aid in conserving natural rubber and maintain the quality of products to render as efficient service as possible.

Important revisions in the tests for automotive hydraulic brake hose (D 571) and for automotive air brake and vacuum brake hose (D 622) will permit their use for hose made from synthetic rubbers.

Consideration is being given to changes in the oil immersion test for rubber belting covered with other tests in A.S.T.M. D 378.

In the field of insulated wire and cable, the 11 A.S.T.M. specifications were discussed in detail. Since future developments may make changes necessary for wire and cable insulation, the specifications will continue in their present tentative status.

Specifications for cellular rubber products and methods of test for their evaluation have been completed. These are the first standards to be issued by A.S.T.M. covering these products so extensively used in war applications. The work is being expanded to cover sponge rubbers, latex foam, and expanded rubbers.

In the work of widespread interest on low-temperature tests, new methods of test for hardness and modulus at low temperatures will be issued. Also completed were recommended practices for pre-treatment in cold or low-temperature testing.

Additional procedures for inclusion in the Tests of Rubber-Coated Fabrics (D 751) will cover hydrostatic resistance by the Suter method and hydrogen permeability by the Cambridge permeameter. Since rubbing, or abrasion, is a very important characteristic of proofed fabrics, a round-robin series of tests using different types of apparatus is under way and may result in detailed abrasion test procedures.

Existing tentative specifications and tests which will be recommended for adoption as formal A.S.T.M. standards cover tear resistance of vulcanized rubber (D 624), resistance to light checking and cracking (D 518), and sampling and testing rubber latex. (D 640).

Revisions have been developed, many to be incorporated this year, in standards covering the following: indentation of rubber (D 676); compression-deflection characteristics (D 575); compression set (D 395); changes in properties of material in liquids (D 471); and tests of hard rubber products (D 530)—in this latter field a series of round-robin tests are expected to develop pertinent data.

Soaps and Other Detergents

Meetings in New York, March 13 and 14

With a record-breaking attendance, Committee D-12 on Soaps and Other Detergents at its several meetings at the Hotel New Yorker, New York City, on March 13 and 14 took a number of actions on methods of analysis of soaps and other detergents and also considered many of its specifications. After incorporating certain changes, the Specifications for Tetrasodium Pyrophosphate (Anhydrous) (D 595 – 42 T) will again be published as tentative, and of interest to those concerned with this material was the decision to make some changes in the Tentative Methods of Sampling and Chemical Analysis (D 501 – 41 T), where the section covering TSPP will continue as tentative with the other portions of these methods giving requirements on caustic soda, trisodium phosphate, sodium metasilicate, and sodium sesquisilicate, etc., recommended for adoption as standard. Also to be balloted on for adoption are the following tentative specifications: Compound Powdered Soap (D 691), Compound Chip Soap (D 690), Trisodium Phosphate (D 538), Built

Soap, Powdered (D 533), and Special Detergents (D 501), and Tentative Methods of Sampling and Chemical Analysis of Soaps and Soap Products (D 460).

Among new activities reported are proposed specifications for liquid soap containing 15 per cent of anhydrous soap material. The proposed methods of chemical analysis of industrial metal cleaning compositions, previously published for information and comment, are to be recommended for issuance as tentative standards. These methods cover compositions in solid, paste, or liquid form, containing a wide variety of materials. Considerable effort was devoted to make the material as complete as possible.

A rather extensive addition to the Annotated Bibliography of Aluminum Cleaning was approved for publication. The first bibliography, issued in the January and March 1943 ASTM BULLETINS, was received with much interest by large numbers of people concerned with this field. It included pertinent information on various types of commercial cleaning methods, means for inhibiting corrosion, and discussions of laboratory techniques for evaluating various detergents. Early publication of the supplemental material is anticipated.

Work has been under way on a monograph on cleaning and also material dealing with corrosion testing of water-soluble aluminum cleaners. Based on discussion at the meeting, these are to be re-edited. During the year, work is expected to be done on fig soap, tall oil soap and dry cleaning soaps, other liquid soaps and methods of analysis, particularly free alkali potash soaps and the analysis of mixtures of soaps and synthetic detergents. The present definitions were revised in the light of criticism advanced during the year, and several other definitions were written.

Following completion of the A.S.T.M. technical work there was considerable discussion on proposed changes in soap specifications issued by the Army Quartermaster Corps and at one of the subcommittee meetings the committee members cooperated in commenting on proposed requirements for commodities used in dry cleaning, these discussions being carried on with representatives of the Quartermaster Corps present, the aim being to provide as helpful information as possible.

Plastics

(Meeting of Committee D-20, Philadelphia, February 23 and 24)

The Society through its Committee D-20 on Plastics has issued a number of test methods for evaluating various properties of plastics and a notable development during the past two years has been the promulgation of some 25 purchase specifications for various grades and kinds of plastics. At its Philadelphia meetings during which there was held an extensive Symposium on Plastics, the committee also took numerous actions on additional specifications and tests, and revisions.

Among the new proposed standards is one for determining tensile properties of thin plastic sheets and films, specimens being prepared by cutting from either cast, extruded or sheeted films. Another important standard gives procedures for determining luminous reflectance and transmission characteristics and color of plastic materials which is set up as a referee method. The permanent effect of heat on plastics can be determined by another new standardized test method and there is a new stability test for chlorine-containing-plastics and test for determining specific gravity.

Three types are covered by proposed new purchase specifications: cellulose and methacrylate molding compounds and cellulose acetate plastic sheets.

The committee is constantly incorporating improvements in its test methods in order to keep these and the specifications in line with latest industrial practice; also, to take advantage of new data that have become available in evaluating these organic materials. Changes which will be proposed involve such tests as brittleness (D 746), tensile properties (D 638), deformation (D 621), heat distortion (D 648), etc.

New work which the committee will undertake at the suggestion of industry or Government branches, includes the simultaneous molding of specimens used for electrical and mechanical tests; a mold flow test to be used as production identification tool, and moisture permeability.

Textile Materials

Committee D-13 Meeting, New York City, March 8 to 10

WITH A total registration for the three days of 256, the largest attendance yet, and some 20 meetings of subcommittees and sections, the spring meetings of Committee D-13 on Textile Materials were very successful. All sessions were at the Park Central Hotel extending from March 8 to 10.

One of the interesting topics discussed in some detail was a proposed Universal Yarn Numbering System, Grex, submitted by the subcommittee on definitions and the several yarn groups. A short paper by A. G. Scroggie describing the derivation and advantages of this system is published on page 44 of this BULLETIN. It should be of interest to all those concerned with yarns.

Other problems which were covered in various meetings include the following: a proposed method for rayon fatigue testing applicable to tire cord; improved accuracy for sampling and measuring methods for wool; air permeability method for felt; number of tests for various test methods for woolen and worsted yarns, and the formulation of a method of determining single twist in plied woolen and worsted yarns; asbestos cloth specifications; development of specifications for civilian goods during wartime; methods of determining number for glass yarns and methods of test for glass silver.

Following its regular procedure the committee held a general technical session at which several papers on problems involving cotton were presented, those participating including G. T. Wilde, President, Cokers' Pedigreed Seed Co.; B. L. Whittier, Mt. Vernon-Woodberry Mills; J. M. Cook, U. S. Department of Agriculture. Captain R. P. Benedict presented an informal discussion of the application of statistical methods in controlling the quality of textile materials.

New Members to March 15, 1944

The following 116 members were elected from January 18 to March 15, 1944:

Chicago District

Belle City Malleable Iron Co., Russell J. Anderson, General Superintendent, 1442 Forest St., Racine, Wis.

Bendix Products Division, Bendix Aviation Corp., K. M. Wise, Director of Engineering, South Bend 20, Ind.

Operadio Manufacturing Co., R. H. Larson, Engineer, St. Charles, Ill.

Pettibone Mulliken Corp., C. V. Nass, Manager, Foundry Div., 4710 W. Division St., Chicago 51, Ill.

Standard X-Ray Co., Mario Iona, Chief Electrical Engineer, 1942 N. Burling St., Chicago 14, Ill.

Waylite Co., The, Paul M. Woodworth, Director of Research and Development, 105 W. Madison St., Chicago 2, Ill.

Balke, Clarence W., Research Director, Division 1, Fansteel Metallurgical Corp., North Chicago, Ill.

Caskey, George R., Metallurgical Engineer, Bliss & Laughlin, Inc., 155th St., Harvey, Ill.

Drapeau, Joseph E., Jr., Technical Director, Metals Refining Co., Hammond, Ind.

Kondrat, Dimitrie S., Chief Chemist, National Lead Co., 900 W. Eighteenth St., Chicago 80, Ill.

Murdoch, B. M., Engineer of Buildings, Illinois Central Railroad Co. 135 E. Eleventh Pl., Chicago 5, Ill.

Newell, Foster S., Metallurgist, Automatic Products Co., 2450 N. Thirty-second St., Milwaukee 10, Wis.

Cleveland District

Cleveland Electro Metals Co., The, John W. Brown, President, 2391 W. Thirty-eighth St. and NKP R. R., Cleveland 13, Ohio.

Formed Steel Tube Inst., Arthur F. Zoll, Consulting Engineer, 1621 Euclid Ave., Cleveland 15, Ohio.

Curry, Gordon C., Manager, War Products Div., The Hoover Co., North Canton, Ohio.

Trautman, H. A., Manager of Production, Standard Alloy Co., Inc.; Owner, Trautman Chemical Engineering, 1515 Coit Ave., E. Cleveland 12, Ohio.

Detroit District

GMC Truck and Coach Division, General Motors Corp., G. C. Farnsworth, Metallurgist, 660 South Blvd., East, Pontiac 11, Mich.

Jones, Edgar W., Chrysler Corp., Engineering Div., Detroit, Mich. For mail: 18515 Coyle Ave., Detroit 19, Mich.

McCauley, Edwin J., Metallurgist, American Metal Products Co., 5959 Linsdale Ave., Detroit, Mich. For mail: 6561 Calhoun, Dearborn, Mich. [J]*

Russell, Cecil H., Chief Chemist, Monsanto Chemical Co., Trenton, Mich.

Weaver, Harry A., Jr., Steel City Testing Laboratory, 8843 Livernois Ave., Detroit 4, Mich.

New York District

Atlas Foundry Co., F. B. Mundy, General Manager, 517 Lyons Ave., Irvington, N. J.

Bordow Co., Henry Cohn, Textile Chemist, 641 Sixth Ave., New York 11, N. Y.

Cordo Chemical Corp., Corydon M. Grafton, Director of Research, 34 Smith St., Norwalk, Conn.

Gumm Chemical Co., Inc., Frederick, R. R. Sizelove, Technical Director, 538 Forest St., Kearny, N. J.

Hoe and Co., Inc., R., Arthur J. Hart, Division Manager, Foundry Div., North Ave., Dunellen, N. J.

Nuodex Products Co., Inc., Arthur Minich, Vice-President, 830 Magnolia Ave., Elizabeth, N. J.

Stroock & Wittenberg Division of U. S. Industrial Chemicals, Inc., K. A. Earhart, Research Director, 390 Doremus Ave., Newark 5, N. J.

Textile Research Inst., Inc., Douglas G. Woolf, First Vice-President, 10 E. Fortieth St., New York 16, N. Y.

Thermal Syndicate, Ltd., The, William W. Winship, Manager, 12 E. Forty-sixth St., New York 17, N. Y.

Waterbury Farrel Foundry and Machine Co., The, I. H. Tolles, Engineer, Rolling Mills Div., Box 70, Waterbury 86, Conn.

Cohen, M. U., Gussack Machined Products Co., 10-20 Forty-fifth Rd., Long Island City 1, N. Y.

Cook, Herbert K., Chemical Engineer, Central Concrete Lab., Corps of Engineers, U. S. Army, 320 Washington St., Mount Vernon, N. Y.

Demarest, Edwin J., Chief Procurement Inspector, Army Air Force, Eastern Procurement District, 90 Church St., New York, N. Y. For mail: 61 Clark St., Paterson 1, N. J.

Dukert, Andrew A., Chief Inspector, Plastic Manufacturers, Inc., Stamford, Conn. For mail: 868 High Ridge Rd., Stamford, Conn.

Faber, Roy, Textile Chemist, Lehn & Fink, Inc., 192 Bloomfield Ave., Bloomfield, N. J. For mail: 87 Palmer Ave., Staten Island 2, N. Y.

Greene, Ralph D., Technical Service Dept., Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J.

Ingmanson, John H., Vice-President, The Whitney Blake Co., Box K, Hamden, New Haven, Conn.

Kropf, Richard T., Director of Research, Belding Heminway Corticelli Co., 119 W. Fortieth St., New York 18, N. Y.

Lukash, John G., Research Chemist, H. Kohnstamm and Co., Inc., 87 Park Pl., New York, N. Y. For mail: 96 Delafield Ave., Staten Island, N. Y.

Mather, Bryant, Assistant Engineer, Central Concrete Lab., Corps of Engineers, U. S. Army, 320 Washington St., Mount Vernon, N. Y.

Pruzansky, Joseph W., Research Assistant, SAM Labs., Columbia University, New York, N. Y. For mail: 1320 Croes Ave., Bronx 60, New York, N. Y. [J]

Schnopper, Isidore, Assistant Chief Chemist, U. S. Bureau of Customs, Division of Laboratories, 201 Varick St., New York 14, N. Y. For mail: 1510 Ocean Parkway, Brooklyn 30, N. Y.

Worth, S. Victor, Aviation Cadet, 2165 E. Seventh St., Brooklyn, N. Y. [J]

Young, Henry L., Vice-President, Aridye Corp., Fair Lawn, N. J.

Northern California District

Schlage Lock Co., D. E. Golden, General Manager, Box 3324, San Francisco 19, Calif.

Azam, Muhammad Ali, Chemist, The Paraffine Cos., Inc., Emeryville, Calif. For mail: 2001 Allston Way, Berkeley 4, Calif.

Hogue, John M., Assistant Chemist, National Bureau of Standards, 209 Old Mint Bldg., San Francisco, Calif. For mail: 958 Ordway St., Berkeley 6, Calif.

Wallace, Philip B., Jr., General Manager, United States Pipe and Manufacturing Co., San Francisco, Calif. For mail: 249 First St., San Francisco 5, Calif.

Philadelphia District

Cramp Brass and Iron Foundries Division ,The Baldwin Locomotive Works, J. J. Nelson, General Manager, Paschall P. O., Philadelphia 42, Pa.

Grammes and Sons, Inc., L. F., Carl J. Swartz, Chemist, Allentown, Pa.

Metlab Co. (Metallurgical Laboratories, Inc.), Horace C. Knerr, President, 1000 E. Mermaid Lane, Philadelphia 18, Pa.

Allen, E. Y., Chief Engineer, Reading Company, 505 Reading Terminal, Philadelphia 1, Pa.

Carver, William S., Designer, Baldwin-Southwark Division, The Baldwin Locomotive Works, Paschall P. O., Philadelphia 42, Pa. For mail: 2 S. Swarthmore Ave., Ridley Park, Pa. [J]

Fasnacht, Roy H., Senior Materials Engineer, Pennsylvania Department of Highways, 1118 State St., Harrisburg, Pa.

Holbrook, George E., Assistant Director, Jackson Laboratory, E. I. du Pont de Nemours and Co., Inc., Box 525, Wilmington 99, Del.

Knarr, Robert E., Division Chief Chemist, Lone Star Cement Corp., Nazareth, Pa.

Stoudt, Robert Frank, Chief Chemist, New York Shipbuilding Corp., Camden, N. J. For mail: 135 Harvard Ave., Collingswood, N. J. [J]

Wolf, Fred L., Executive Vice-President, Ross-Tacony Crucible Co., Tacony, Philadelphia 35, Pa.

Pittsburgh District

Ball Chemical Co., George L. Ball, Jr., Vice-President, Glenshaw, Pa.

Pennsylvania Coal Products Co., C. F. Hosford, Jr., President, Petrolia, Pa.

Pittsburgh Coke and Iron Co., George L. Kirp, Superintendent, Cement Plant, Grant Bldg., Pittsburgh, Pa.

Plastic Metals, Inc., B .T. du Pont, General Manager, 221 Central Ave., Johnstown, Pa.

Treadwell Construction Co., F. G. Gramm, Vice-President, 600 S. Twelfth St., Midland, Pa.

BARBOUR, ALFRED C., Manager, Roessing Bronze Co., Butler Plank Rd., Etna, Pa.

CODE, CHARLES J., Engineer of Tests, Maintenance of Way, The Pennsylvania Railroad Co., Test Dept., Sixteenth St., Altoona, Pa.

FISHER, T. W., Assistant Engineer of Tests-Chemical, The Pennsylvania Railroad Co., Test Dept., Altoona, Pa.

GASKIN, CLEMENT P., Inspector, Army Ordnance Matériel, U. S. War Dept., Pittsburgh Ordnance District, Chamber of Commerce Bldg., Pittsburgh 19, Pa. For mail: 1609 Kimball Ave., New Kensington, Pa.

HAMMOND, M. B., Vice-President, Standard Steel Spring Co., Coraopolis, Pa. For mail: 317 Meadow Lane, Edgeworth, Sewickley, Pa.

HART, F. C., Chief Metallurgist, Clairton Works, Carnegie-Illinois Steel Corp., Clairton, Pa.

KAUFMAN, CHARLES E., Research Engineer, Hall Laboratories, Inc., Box 1346, Pittsburgh 30, Pa.

KIRP, GEORGE L., Superintendent, Green Bag Cement Co. of Pennsylvania, Neville Island, Pa.

St. Louis District

BUSCH-SULZER BROS.-DIESEL ENGINE CO., R. Schlatter, Chief Mechanical Engineer, 3300 S. Second St., St. Louis 18, Mo.

KOMARNITSKY, R. S., Chief Metallurgical Engineer, Standard Steel Spring Co., Gear and Axle Div., Box 230, Madison, Ill.

PAGE, CARLISLE W. C., Chief Chemist, Koppers United Co., Blast Furnace Div., Granite City, Ill.

WELLS, W. L., Chief Engineer, Curtiss-Wright Corp., Airplane Div., St. Louis Plant, Lambert Field, St. Louis 21, Mo.

Southern California District

BALL, LESLIE W., Assistant Technical Director, Triplett & Barton, Inc., 826 N. Victory Blvd., Burbank, Calif. For mail: 209 N. Griffith Park Dr., Burbank, Calif.

MOREY, JAMES B., Engineer and Assistant Metallurgist, The International Nickel Co., Inc., 705 Petroleum Bldg., 714 W. Olympic Blvd., Los Angeles 15, Calif.

Western New York-Ontario District

CLARK BROTHERS CO., INC., F. M. McNall, Director of Research, Olean, N. Y.

AVERBACK, B. L., Chief Metallurgist, U. S. Radiator Corp., Geneva, N. Y. [J]

BEEBE, E. D., Chief Engineer, Ritter Co., Inc., 400 West Ave., Rochester 3, N. Y.

U. S. and Possessions

OTHER THAN A.S.T.M. DISTRICTS"

ABERDEEN CONCRETE CO., INC., William M. Lindenstruth, Vice-President, Box 499, Aberdeen, Md.

AMOS MOLDED PLASTICS, DIVISION OF AMOS-THOMPSON, CORP., J. C. Kazimier, Chief Engineer, Edinburg, Ind.

CALLAWAY INST., INC., W. P. Cofield, Jr., Chief Testing Engineer, Fourth Ave. and Washington St., LaGrange, Ga.

KELLEY-KOETT MANUFACTURING CO., THE, R. W. Mayer, Manager, Industrial Sales, 212 W. Fourth St., Covington, Ky.

KEYSTONE CARBON CO., INC., W. P. Gies, Research Engineer, 1935 State St., St. Marys, Pa.

NORGE DIVISION, BORG-WARNER CORP., Julius C. Scharmer, Chief Chemist, 88 W. Broadway, Muskegon Heights 61, Mich.

ROGERS PAPER MANUFACTURING CO., THE, Sol. Baker, Development Engineer, Goodyear, Conn.

SEYMOUR WOOLEN MILLS, Don A. Bollinger, President, Seymour, Ind.

ALTER, CHESTER M., Professor of Analytical Chemistry, Department of Chemistry, Boston University, Boston, Mass.

AMBERG, CHARLES R., Head, Department of Ceramic Research, New York State College of Ceramics, Alfred, N. Y.

BROWN, J. E., Superintendent, Motive Power, St. Louis Southwestern Railway Co., Pine Bluff, Ark.

BUNN, EDWARD S., Metallurgical Manager, Revere Copper and Brass, Incorporated, 1301 Wicomico St., Baltimore 3, Md.

CHADD, G. K., Chief Chemist, Cosden Petroleum Corp., Box 1311, Big Spring, Tex.

DEVILLIERS, T. E., Chief Chemist, Cities Service Oil Co. (Del.), Research Lab., Okmulgee, Okla.

FISHER, W. R., Testing and Development Laboratory Worker, North Electric Manufacturing Co., Galion, Ohio. For mail: 427 Harding Way West, Galion, Ohio.

GRACE, R. H., Control Metallurgist, Remington Arms Co., Inc., Ilion, N. Y.

LANGSTON, HENRY P., Metallurgist, Springfield Armory, Springfield, Mass. For mail: 44 Garden St., Springfield 9, Mass.

MONTFORT, HAROLD E., Material Research Engineer, Dayton Power and Light Co., 25 N. Main, Dayton 1, Ohio.

MURPHY, D. F., Metallurgist, Struthers-Wells Co., Titusville Forge Division, Titusville, Pa.

NICHOLS, MARVIN C., Consulting Engineer, Freese & Nichols, 407 Capps Bldg., Ft. Worth 2, Tex.

RANDOLPH, E. E., Head, Chemical Engineering Dept., North Carolina State College, Raleigh, N. C.

RICHMOND, J. L., President, Union Concrete Pipe Co., Ceredo, W. Va.

SWAILES, EARL JACK, Director of Quality, American Aviation Corp., Jamestown, N. Y. For mail: R. F. D. 1, Benus Point, N. Y.

TUCKER, ALFRED SCOTT, Development Metallurgical Engineer, General Electric Co., River Works, Lynn, Mass. For mail: 65 Oak St., Milton, Mass.

VAN PELT, A. T., General Superintendent, Berry Asphalt Co., Waterloo, Ark.

VODONICK, E. J., Standards Engineer, North American Aviation, Inc., Kansas City 17, Kans. For mail: 104 First St., N. W., Chisholm, Minn. [J]

Other than U. S. and Its Possessions

INSTITUTO TECNOLÓGICO DO RIO GRANDE DO SUL, Professor Ivo Wolff, Civil Engineer, Av. Osvaldo Aranha 271, Porto Alegre, Rio Grande do Sul, Brazil.

JESSOP AND SONS, LTD., WILLIAM, Brightside Works, Sheffield, England.

RCA VICTOR CO., LTD., Allan B. Oxley, Chief Engineer, 1001 Lenoir St., Montreal, P. Q., Canada.

RESEARCH ENTERPRISES LIMITED, George C. Elliott, Radio Engineer, Procurement Dept., Leaside, Ont., Canada.

WROUGHT LIGHT ALLOYS DEVELOPMENT ASSN., E. G. West, Manager, Union Chambers, 63 Temple Row, Birmingham 2, England.

GASTEAZORO, JOSE, JR., Civil Engineer, Box 377, San Salvador, El Salvador. [J]

LAMONT, W. J., Commercial Manager, South African Iron and Steel Industrial Corp., Ltd., Box 450, Pretoria, South Africa.

WELLWOOD, ROBERT WILLIAM, Wood Technologist, Commonwealth Plywood Co., Ltd., Ste. Therese, P. Q., Canada.

YACIMIENTOS PETROLIFEROS FISCALES, Instituto de Investigaciones, Florencio Varela (F. C. S.), Argentina.

* [J]—Denotes Junior Member.

Personals

• • • News items concerning the activities of our members will be welcomed for inclusion in this column.

Dean BRADLEY STOUGHTON is to be honored at a dinner at the Hotel Bethlehem on April 15 on his retirement from active teaching duty in metallurgy at Lehigh University. A member of A.S.T.M. since 1902, he has served on various A.S.T.M. technical committees. He has contributed a number of technical papers, several of which have been published in the A.S.T.M. *Proceedings*. Prior to his service at Lehigh which began in 1923 he was secretary and executive officer of the American Institute of Mining and Metallurgical Engineers, and earlier was on the faculty of the School of Mines, Columbia University.

L. N. BRYANT, formerly Superintendent, Cement Division, Pittsburgh Coke and Iron Co., Neville Island, Pa., is now Manager, Cement Department, Hawaiian Gas Products, Ltd., Box 2454, Honolulu, Oahu, T. H.

L. P. McALLISTER is now Assistant to the General Superintendent, with specific duties of quality control, Lukens Steel Co., Coatesville, Pa. He was formerly Metallurgical Engineer for this company.

A. W. DEMMLER, who was Metallurgical Engineer, Vanadium Corp. of America, New York, N. Y., is Director of Metallurgy and Research, Campbell, Wyant and Cannon Foundry Co., Muskegon, Mich.

J. L. SAVAGE, Chief Designing Engineer, U. S. Bureau of Reclamation, Denver, Colo., has left on a special Far Eastern Mission. His plans for the trip tentatively include a four-month stay in India, where he will work on the design of a large irrigation dam, and a six-month stay in China, where he will work on the design of three projected dams.

STANTON WALKER, Director of Engineering, National Sand and Gravel Association, Washington, D. C., was elected chairman of the Highway Research Board at the annual meeting of the organization, which was held in Chicago late in 1943.

V. R. WILLOUGHBY, formerly Vice-President, In Charge of Engineering, American Car and Foundry Co., New York, N. Y., is now Director of Research and Development, American Car and Foundry Co., New York, N. Y.

GILBERT E. SEIL who was Technical Consultant, E. J. Lavino and Co., Philadelphia, Pa., is now associated with Day & Zimmermann, Inc., Philadelphia, as Technical Consultant.

WALTER G. HILDORF, formerly Chief Metallurgical Engineer, Timken Roller Bearing Co., Canton, Ohio, has been made Director of Metallurgy, a newly created office in the company.

H. J. HUESTER, formerly with Reynolds Metals Co., as Technical Adviser and Director of Quality and Inspection at aluminum plants at Louisville, Ky., and Lister Hill, Ala., is now a Bureau of Aeronautics General Representative at Wright Field, Dayton, Ohio, with the rating of Lieutenant Commander.

JOHN G. McMILLAN, who was Testing Engineer, The Omaha Testing Laboratories, Inc., Omaha, Nebr., is now Chemist, Scientific Products Co., Council Bluffs, Iowa. His home address remains 1201 S. Fifty-second St., Omaha 6, Nebr.

The nominating committee of the Chemical and Metallurgical Engineering Section, Western Society of Engineers, has nominated the following two Corporate Members as Directors of the Section, for a term of three years beginning June 1, 1944: ROBERT B. HARPER, Vice-President, The Peoples Gas Light and Coke Co., Chicago, Ill., and H. H. MORGAN, Chief Engineer, Robert W. Hunt Co., Chicago.

At a meeting of the nominating committee of the American Foundrymen's Association held in Chicago in January several A.S.T.M. members were nominated as follows: RALPH J. TEETOR, President, Cadillac Malleable Iron Co., Cadillac, Mich., as President; and FRED J. WALLS, Manager, Detroit Office, Development and Research Division, The International Nickel Co., Inc., Detroit, Mich., as Vice-President.

ELLWOOD L. BARTZ, who was Assistant Civil Engineer, Head of Soil Section, Materials Testing Laboratory, U. S. Engineer Office, Honolulu, Hawaii, is now Assistant Civil Engineer, Board of Water Supply, City and County of Honolulu, Honolulu, Hawaii.

H. S. MATTIMORE, Senior Civil Engineer, Civil Engineering Corp., U. S. Navy, Wilmington, N. C., who for a quarter of a century was Engineer of Tests and Research of the Pennsylvania State Highway Department, was on February 2 presented the George S. Bartlett Award for distinguished and outstanding contribution to highway progress. The Award was presented at the Postwar Highway Conference of the American Road Builders' Association in Chicago, February 1, 2, and 3.

WILLIAM R. SHERIDAN, formerly Chief Chemist, Dunlop Tire and Rubber Corp. of America, Buffalo, N. Y., is now Materials Engineer, Colonial Radio Corp., Buffalo, N. Y.

J. A. KIRKPATRICK, who was Superintendent of Inspection, Ellwood Works, National Tube Co., Ellwood City, Pa., is now Chief Inspector, Tubular Alloy Steel Corp., Gary, Ind.

D. W. STEWART formerly Manager of Technical Service, Basic Magnesium, Incorporated, Las Vegas, Nev., is now connected with Light Alloys, Ltd., Renfrew, Ontario, Canada.

JUNIUS D. EDWARDS, Assistant Director of Research, Research Laboratories, Aluminum Company of America, received this year's Pittsburgh award by the Pittsburgh Section of the American Chemical Society at a dinner meeting in the University Club on February 17.

C. E. MacQUIGG, Dean, College of Engineering, and Director, Engineering Experiment Station, Ohio State University, was given the James Turner Morehead Medal of the International Acetylene Association on January 24 in New York for "advancing the oxy-acetylene processes through metallurgical research, and for leadership in welding engineering education." The Morehead Medal is awarded annually in recognition of outstanding work in the acetylene industry or for advancements in the production or use of calcium carbide.

JOHN EKERN OTT, Manager, Archer Plant, Acme Steel Co., Chicago, Ill., has been appointed District Director of Training Within Industry for Illinois and Wisconsin (District No. 15) with offices at 222 West Adams St. Mr. Ott is retaining his industrial connection with the Acme Steel Co.

HERBERT S. SCHENKER, formerly Head, Textile, Leather and Apparel Section, Standards Division, Office of Price Administration, Washington, D. C., is now connected with the United Nations Relief and Rehabilitation Administration, Washington, D. C., as Associate Chief, Clothing, Textiles and Footwear Branch.

ERIC WEYL who was with Textile Industry Research, Inc., New York, N. Y., as Consultant, is now Consulting Textile Engineer, Chicopee Manufacturing Corp., Chicopee Falls, Mass.

E. C. CHAPMAN, Metallurgist in Charge of Welding Research, Hedges-Walsh-Weidner Division, Combustion Engineering Co., New York, N. Y., has been elected Vice-President of the Southern District of the American Welding Society.

JOHN D. GOLD, former Chief Metallurgist, Weirton Steel Co., a subsidiary of National Steel Corp., at Weirton, Va., has been appointed Assistant Vice-President in Charge of Quality Control, and its supplemental departments for Weirton.

At the recent annual meeting of the American Institute of Mining and Metallurgical Engineers several A.S.T.M. members were honored as follows: The Eleventh Institute of Metals Division Award was made to ROBERT F. MEHL, Director, Metals Research Laboratory, and Head, Department of Metallurgy, Carnegie Institute of Technology, Pittsburgh, Pa.; C. S. BARRETT, Carnegie Institute of Technology, Pittsburgh, Pa.; and Alfred H. Geisler, Research Metallurgist, Aluminum Research Laboratories, New Kensington, Pa., for their paper entitled "Mechanism of Precipitation from Solid Solutions of Zinc in Aluminum, Magnesium in Aluminum, and Some Magnesium-base Alloys" presented at the Annual Meeting of the Institute of Metals Division, February, 1943. W. M. PEIRCE, Chief, Research Division, The New Jersey Zinc Co., Palmerton, Pa., presented the Twenty-third Annual Institute of Metals Division Lecture on the subject "Some Problems in Organizing Industrial Research." The Twenty-first Howe Memorial Lecture was delivered by JAMES T. MacKENZIE, Chief Metallurgist, American Cast Iron Pipe Co., Birmingham, Ala., on the subject "Cast Iron—Steel Plus Graphite."

LLOYD M. MORRIS, formerly with the Pennsylvania Railroad Co., is now Director of Laboratories, U. S. Army, Office of Quartermaster General Military Planning Division, Research and Development Branch, Washington, D. C. Colonel Morris was located earlier at Camp Lee, Va., in Q.M.R.T.C.

JOHN A. RODGERS, formerly Engineer in Charge of Physical Testing Laboratory, Stromberg-Carlson Co., Rochester, N. Y., is now Quality Control Engineer, The Camera Works, Eastman Kodak Co.

COL. M. B. CHITTICK formerly of the Matériel Command, Chemical Warfare Service, War Department, Gravelly Point, Va., is now Commanding, Camp Detrick, Frederick, Md. Colonel Chittick, who has been active in A.S.T.M. work, and also in the Lubricating Grease Institute, was, before he entered the service Manager, Specialty Sales, The Pure Oil Co., Chicago, Ill.

PIERRE DREWSEN, Chemical Engineer, Hinde & Dauch Paper Co., Sandusky, Ohio, has been elected to the Executive Committee of the Technical Association of the Pulp and Paper Industry for a term of three years.

FRED J. TOBIAS, formerly Consulting Engineer, Graphitized Alloys Corp., New York, N. Y., is now with Sam Tour and Co., Inc., New York, N. Y.

NECROLOGY

We announce with regret the death of the following members and representative:

J. Brown, Vice-President and General Manager, El Rey Products Co., Los Angeles, Calif.

L. H. Dunham, Assistant Manager, Metallurgical Dept., American Steel and Wire Co., Cleveland, Ohio. Member since 1938. At the time of his death Mr. Dunham represented his company in its membership on Committee A-1 on Steel; also on the Joint A.W.S.-A.S.T.M. Committee on Filler Metal and several of its subcommittees.

Arthur E. Owen, Chief Engineer, The Central Railroad Co. of New Jersey, Jersey City, N. J. Personal member since 1939, and represented The Central Railroad Co. of New Jersey in its membership since 1917. Until recently Mr. Owen had also been Chief Engineer of The Reading Co., Philadelphia, Pa.

W. E. Perdew, Consultant, Wichita, Kans. Member since 1920. Mr. Perdew was a member of Committee D-1 on Paint, Varnish, Lacquer, and Related Products from 1924 until his death. He had formerly served on Committee D-2 on Petroleum Products and Lubricants and the A.S.A. Sectional Committee on Petroleum Products and Lubricants.

Standards Solve Laboratory Problems

An article in January *Industrial Standardization* by J. J. Wocasek, Jeffersonville Quartermaster Depot, stresses the uses of standards in solving laboratory problems, many of which have been intensified because of the war effort and the necessity of having close control on quality. He refers to the importance of interchangeable parts and the desirability in certain cases of standardizing instruments regularly, in the case of micrometers for example, daily. He cites the value of comparison standards in connection with chemical solutions and finally stresses the importance of standard methods as tools in analytical procedures. In developing adequate inspection methods, he cites a case of salt spray tests made on "zinc die castings" which did not show expected products but evidence of iron-oxide rust. After considerable discussion and studies, one technician applied a magnet, and it was quite apparent that instead of die castings the products turned out to be steel base with a zinc coating, after which in this particular laboratory, it is reported, a magnet test was a standard procedure for peculiar cases.

In summary, he writes:

"The unprecedented demands brought about by the war effort have compelled industry to employ great numbers of unskilled workmen in attempting to meet manufacturing goals. Because of this condition and the vital nature of the product, it is necessary to have constant assurance that high quality is maintained. This is secured in a two-fold manner: First, by establishing rigid standards in manufacturing procedures; and second, by continual examination of the raw materials and the finished item in a modern testing laboratory.

"Since both of the above criteria are themselves subject to error, they must be firmly governed by a complete and detailed standardization program. This must control and rectify all phases of testing including tools, instruments, materials, and methods.

"The number of tests performed on control sample should be sufficient to evaluate it properly. A correlation of data rather than individual results should be employed in determining the acceptability of the item."

A.S.T.M. MEMBERSHIP

(For complete information see Year Book; or literature is obtainable from A.S.T.M. Headquarters, 260 South Broad Street, Philadelphia 2, Pa.)

	Entrance Fee	Annual Dues	Publications
MEMBERS—Individuals, companies, associations, laboratories, government departments, technical schools, and libraries.			
Membership Qualifications: Endorsement by two A. S. T. M. members and election by the Executive Committee			
Sustaining Members	$10 Usually waived	$100	All A.S.T.M. publications;[1] also second set of complete Book of Standards and additional copies of Bulletin without charge on request.
Company Members (Including firms, associations, etc.)	$10	$30	Bulletins, Year Book, Proceedings, Preprints, Volume on Chemical Analysis of Metals, New and Emergency Standards and Emergency Alternate Provisions, Index to Standards, and one Part of Book of Standards and Supplements. (Two Parts $1.50, all three $2.50 yearly.)
Individual Members (Membership fees and publications furnished are same for Government departments, technical schools, and libraries.)	$10	$15	
JUNIOR MEMBERS—Individuals less than 27 years old. Status changed to members at beginning of next fiscal year after reaching 27 years of age.	$5	$7.50	Same as for Individual Members.
STUDENT MEMBERS—Undergraduate or graduate students in technical schools or students less than 25 years old taking technical courses in an apprentice or night school. Status changed to Junior Member after leaving school.	None	$1.50	Bulletins, Year Book, Preprints, Special Engineering Student compilation or any one of special compilations of standards.

Cost of Membership in Perpetuity is $600, but is $300 to technical or scientific societies, libraries, and similar organizations. Cost of Life Membership to individuals is based upon age.

[1] This includes many publications not regularly furnished the membership on their dues. Full details are available in a booklet describing the advantages of Sustaining Membership.

Note—*The current A.S.T.M. Year Book includes, pages 5 through 14, considerable information on publications, meetings, committees, etc., and also, following page 364, a form for recommending prospective members and membership application blanks.*

EA – A 121

Issued, January 28, 1944

The following Emergency Alternate Provisions, when specified, may be used as an alternate in A.S.T.M. Standard Specifications for Zinc-Coated (Galvanized) Iron or Steel Barbed Wire (A 121 – 39) and affect only the requirements referred to:

Section 1.—Change this section on Scope to read as follows:

1. These specifications cover one class of zinc-coated iron or steel barbed wire (galvanized before fabrication), namely class 1, as described in the following emergency revision of Section 6, designated by weight of coating in ounces of zinc per square foot of uncoated wire surface.

Section 2.—Substitute the following table of Sizes and Constructions for the table now appearing in this section:

Size, Steel Wire Gage	Nominal Diameter of Zinc-Coated Wire in Strand, in.	Commercial Designation	Number of Barbs	Barb Spacing, in.
No. 12½	0.099	Hog	4	4
No. 12½	0.099	Hog	2	4
No. 14	0.080	Hog	2	4

Section 6.—Change this section on Weight and Uniformity of Coating to read as follows:

6. The weight and uniformity of the coating for the various gages of wire composing the strands of the barbed wire shall be specified by the purchaser and shall be in accordance with the weights and Preece test dips prescribed in the accompanying Table I.

Tables I and II.—In place of Tables I and II substitute the following Table I:

TABLE I.—REQUIREMENTS FOR MINIMUM WEIGHT AND UNIFORMITY OF COATING.

Size, Steel Wire Gage	Nominal Diameter of Zinc-Coated Wire in Strand, in.	Minimum Weight of Coating, oz. per sq. ft. of uncoated wire surface	Uniformity of Coating, Minimum Number of Dips in Preece Test
No. 12½	0.099	0.30	1½
No. 14	0.080	0.25	1

EA – A 116

Issued, January 28, 1944

The following Emergency Alternate Provisions, when specified, may be used as an alternate in A.S.T.M. Standard Specifications for Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad Right-of-Way Wire Fencing (A 116–39) and affect only the requirements referred to:

Section 1.—Change this section on Scope to read as follows:

1. These specifications cover one class of zinc-coated iron or steel wire fencing for farm-field fence and railroad right-of-way fence (galvanized before fabrication), namely class 1, as described in the following emergency revision of Section 6, designated by the weights of coating in ounces of zinc per square foot of uncoated wire surface.

Section 2.—Change this section on Style and Size to read as follows:

2. It is recommended that the styles and sizes of fence fabric covered by these specifications shall be in accordance with those provided in the War Production Board Limitation Order L-211, Schedule 3, of latest issue.

Section 6.—Change this section on Weight and Uniformity of Coating to read as follows:

6. The weight and uniformity of coating for the various gages of wire composing the fencing shall be in accordance with the weights and Preece test dips provided in the accompanying Table I.

Tables I and II.—In place of Tables I and II substitute the following Table I:

TABLE I.—REQUIREMENTS FOR MINIMUM WEIGHT AND UNIFORMITY OF COATING

Size, Steel Wire Gage	Nominal Diameter of Zinc-Coated Wire, in.	Minimum Weight of Coating, oz. per sq. ft. of uncoated wire surface	Uniformity of Coating, Minimum Number of Dips
No. 9	0.148	0.40	2½
No. 10	0.135	0.30	1½
No. 11	0.120	0.30	1½
No. 12½	0.099	0.30	1½
No. 14½	0.076	0.25	1
No. 15½	0.067	0.15	1

Section 9 (b).—Change the table of permissible variations in this section to read as follows in order to incorporate the smaller wire gages provided for in the War Production Board Limitation Order L-211, Schedule 3, of latest issue:

Size Steel Wire Gage	Permissible Variations, in.
Nos. 9 to 12, incl	±0.004
Nos. 12½ to 15½, incl	±0.003

EA – B 16

Issued, March 21, 1944

The following Emergency Alternate Provisions, when specified, may be used as an alternate in A.S.T.M. Standard Specifications for Free-Cutting Brass Rod for Use in Screw Machines (B 16 – 42) and affect only the requirements referred to:

Section 4.—Change the table of chemical composition from its present form to read as follows:

Copper, per cent	60.0 to 63.0
Lead, per cent	2.50 to 3.75
Tin, max., per cent	0.30
Iron, max., per cent	0.35
Nickel, max., per cent	0.50
Zinc	remainder
Total other elements, max., per cent	0.50